WELCOME

Orientation Webinar on Outcome-Based Education (OBE) and Accreditation

for Program Evaluators (PEVs)

PEOs, Curriculum and Teaching Learning, Analysis and Attainment of COs & POs

11:35 – 12:45

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PRESENT SCENARIO

- How do teachers perform teaching presently?
- Faculty are assigned a course generally a semester in advance.
- The course syllabus and the curriculum in which the course is positioned are available.
- The syllabus description contains L-T-P-C, units (usually, 5 units- in sequence?) with content detail for each unit, Text book(s), reference book(s)
- We prepare a lesson plan (lecture wise) 5x 9 = 45 approx
- we gather (source) exam questions of some pervious years. We may have previously taught the course.
- The entire process of assessment of students in the course is as per set guidelines in the Regulation – quizzes/homework?/assignments/and internal tests with weightages

SOME OBSERVATIONS ON THE PRESENT APPROACH

- There are no explicit statements pertaining to why we are doing (in teaching the course) what we are doing. What is the purpose - From the student standpoint and the teacher standpoint? Is it just/merely success in the examination? We need to state these.
- The above question is relevant also in the context of the program (BE degree in Engineering in a discipline)
- OBE attempts to make explicit what may have been implicit
- Making Outcomes explicit benefits students, teachers, management/ education administrators and industry/employers – all stake holders

What is an OUTCOME?

Course Outcomes state what a student, on successfully completing the course and earning a pass grade and the credit can perform/do/demonstrate with what he/she has learnt in the course. These are also referred as Learning Outcomes or Student Outcomes and in NBA we use the term Course Outcomes (COs). Note the emphasis on use/application of the knowledge imparted/acquired by a successful student in the course and not on the knowledge per se.

- The central key-concept in OBE is OUTCOMES
- We have course outcomes(COs) and Program outcomes(POs)

First, let us see OBE as a system – for design, implementation and continuous improvement of technical education at the degree level

OBE : Focus - key questions

- What do we want our students to achieve? -

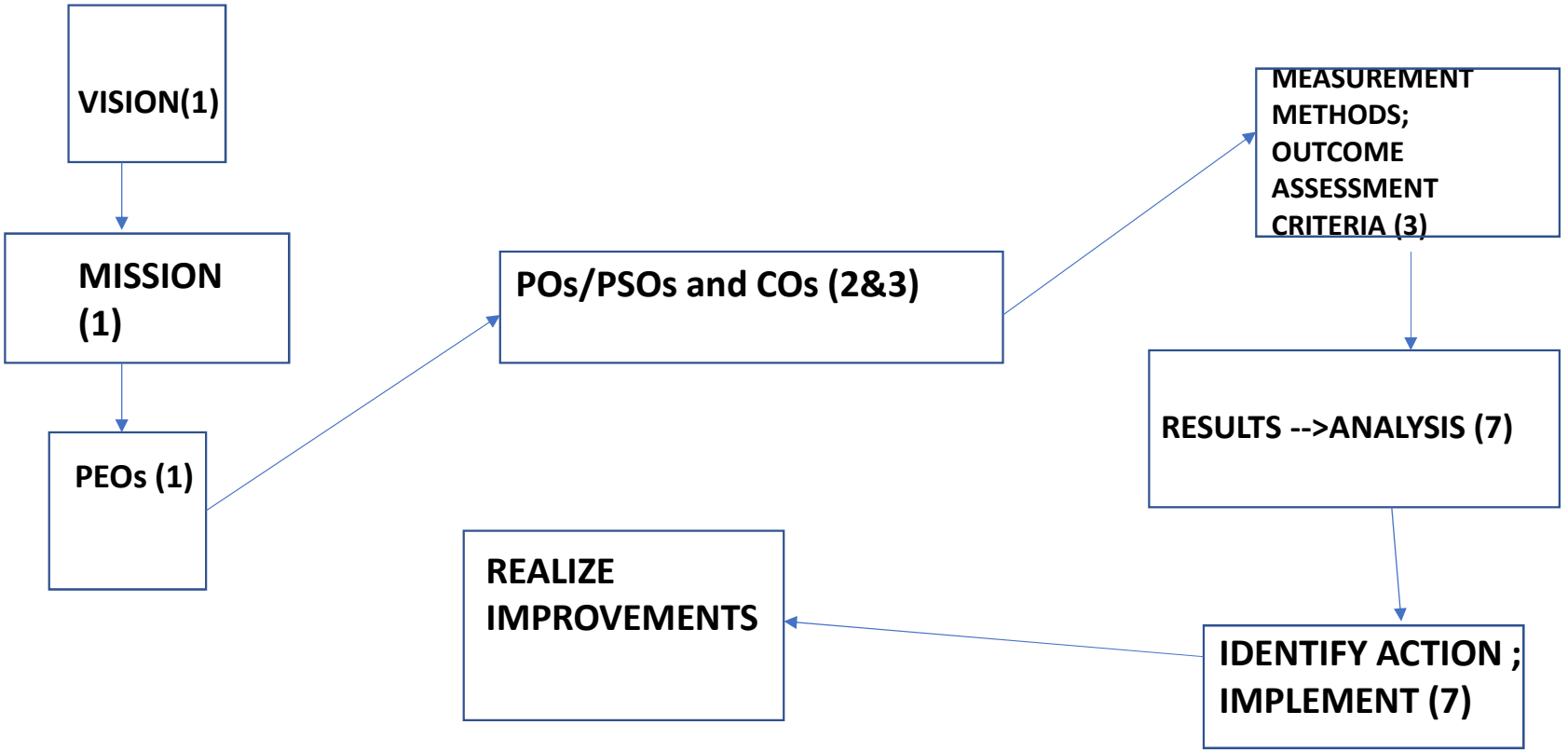
  PROGRAM OUTCOMES [POs]

- How do our students achieve it?

Through the curriculum comprising courses with Course Outcomes [COs], teaching/learning and assessment

- How do we know how well our students have achieved it? Assess attainment of COs and POs
- How do we close the loop for further improvement (Continuous Quality Improvement (CQI))? Make use of the assessment of attainment of COs and POs

OBE overview/model



Program Educational Objectives - PEOs

PEOs are broad statements that describe the career and professional achievements that the program is preparing the graduates to achieve within the first few years after graduation.

generally assessed indirectly via interaction with alumni and industry persons associated with the Program/institute.

PEO Example – Aeronautical Engineering

PEO1. Our graduates will have successful professional careers in industry, government, academia and military as innovative engineers.

PEO2. Our graduates will be successful in solving engineering problems associated with the lifecycle of aircraft systems

PEO3. Our graduates will continue to learn and advance their careers through activities such as participation in professional organizations, attainment of professional certification and seeking higher education.

PEO4. Our graduates will be active members ready to serve the society locally and internationally

Note that PEOs are about what graduates may do after they graduate

SAR – NBA Criteria and Evaluation Scores

Grade Y W C D: Y compliant, W weakness, C concern, D Deficient

1.	Vision, Mission, PEOs	50*
2.	Program Curriculum & Teaching-Learning Processes	100*
3.	Course Outcomes and Program Outcomes	175*
4.	Students' Performance	100
5.	Faculty Information and Contributions	200
6.	Facilities and Technical Support	80
7.	Continuous Improvement	75*

*400/780 = 51.3% criterion 8, 9, 10 for 220 marks

ANNEXURE I
(A) PROGRAM OUTCOMES

Engineering Graduates will be able to:

1. **Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.**

2. **Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.**

3. **Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.**

4. **Conduct investigations of complex problems: Use research-based knowledge and research methods 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 diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and 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.

PSOs – An Example (Civil Engineering)

- PSO1: Proficiency in a specialized area: Demonstrate proficiency in one of the following specialized areas of Civil Engineering i) Construction Materials and Management ii) Structural and Geotechnical Engineering iii) Environmental, water resources and Transportation Engineering

- PSO2: Ability to apply principles of civil engineering for the entire life cycle of the project ranging from initial design to the closure of the project.

- PSO3: Ability to identify and analyse various properties of construction materials and their applications in design and construction of various structures

What underpins complexity?

- Non-linearity
- Dynamic equilibrium
- Operating range and characteristics/behaviour outside the OR
- Reliability/ fault-tolerance and recovery
- Transients/Time variance/ dynamic versus static
- Size/Scale
- Elemental versus System Complexity
- Life-cycle issues for processes and products
- Evolution – Maintainability, Serviceability (RAS)
- Context of use/Interconnection of parts or subsystems
- Functional and Non-functional specifications and partial specifications
- Open-endedness/in-completeness
- Have more than one (many) solutions

Essence captured in HOTS - higher-order thinking skills (BLOOMS TAXONOMY)

Course Outcomes - COs

Given a curriculum, we design and detail courses in terms of syllabus description, pre-requisites, credits (L-T-P-C), text book(s), reference book(s), Question Bank, content details of units, Lesson-Plan, Assessment

Implementing a course comprises:

- TEACHING, LEARNING and ASSESSMENT (QUIZ, Assignment, Exams ..)
- CONSTRUCTIVE ALLIGNMENT OF T, L and A
- ASSESSMENT DRIVEN BY COURSE-OUTCOMES
- ASSESSMENT DRIVES TEACHING AND LEARNING
- COs are central to OBE and OBE is transformational

Assessment of attainment of Outcomes – COs, POs

- OUTCOMES are what our students to achieve by T-L-A
- Therefore, we need to measure how well the outcomes are attained and, use the measurement to identify doable improvements and act on these.
- CO attainment are to be calculated by the teacher at the end of the course
- POs are to be assessed at the end of the program, that is, every year for the graduating batch – may also be assessed in between (partial) for possible in-program improvement.
- Sine POs are achieved by COs, PO assessment will use CO assessment as input and be based on CO-PO matrix which captures the contribution of COs to POs
- CO assessment will be based on how students do in the tests/quizzes, internal/end-semester examinations, assignments/home-work and therefore, we need to capture connection between questions in the exam/test and the COs
- These assessments are for the entire class (i.e., aggregate) – as distinct from individual student performance

An Example of Course Outcomes COs

- Course Title: Heat & Mass Transfer
- Course Outcomes

1 **Solve** practical engineering problems using basic concepts of heat and mass transfer.

2 **Evaluate** steady and unsteady performance for insulation, fin and thermocouple.

3 **Analyze** laminar and turbulent boundary layer flow on internal and external regions.

4. **Design** shell and tube type heat exchangers for convective heat transfer applications.

5 **Analyze** phase change heat transfer processes applied to process-heat applications

6 **Determine** radiation heat transfer rates in engineering problems.

7 **Perform** design calculations of thermal equipment and prepare technical report

CO-PO mapping (connecting COs with POs)

- The mapping is a matrix with rows as COs and columns as POs

Each element/cell of the matrix has a value in {--, 1, 2, 3}

The meaning associated with the values are as follows:

-- this CO (row) has nil/very small/insignificant contribution to the PO(column)

1 → relevant and small significance 2 → medium or moderate and 3 → strong

These values have to be justified in implementing T-L-A of the course, in terms of the BLOOM Level of the questions/Problems

An Example CO-PO mapping (contd ..)

	PO1	PO2	PO3	PO4
CO1	2	2		
CO2		3		
CO3		2	2	
CO4		3	2	
CO5		3		
CO6		2		
CO7			3	3

Course : Data Structures and Algorithms

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1 :	**Apply List ADT in various linear and non-linear data structures**											
Mapping & Justification	**2 Basic concepts of Data structures are introduced**	**2 Various problem domains for which Lists can be used.**	**1 Solutions using List ADT will be analysed**	**1 Usage of List ADT in various domains will be evaluated**	**2 Programming language implementation of solutions**	**1 Application of appropriate data structures to solve real-time problems will be analysed**			**1 Assignments for solving real-time problems using Data structures will be given**	**1 Assignments, Seminars on Content beyond syllabus will be given**		
CO2:	**Implement stacks and queues in applications**											
	1 Fundamentals of stacks / queues	2 Problem analysis to use stacks and queues	1 Analysis of using stacks and queues for various problem	1 Applications of Stacks and queues for will be evaluated	2 Programming language to implementation of solutions	1 Application of appropriate data structures to solve real-world problems will be analysed			1 Assignments for solving real-world problems using Data structures	1 Assignments, Seminars on Content beyond syllabus will be given		

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO3:	Analyse and apply tree data structures											
	1 Fundamental concepts of Trees	2 Various problem domains for which trees can be used	1 Solutions using Trees will be analysed	1 Usage of Trees in various domains will be evaluated	2 Programming implementation of solutions	1 Application of appropriate data structures to solve real world problems			1 Assignments for solving real world problems using Data structures	1 Assignments, Seminars on Content beyond syllabus will be given		
CO4:	Implement algorithms for graphs for problem/application											
	1 Fundamental Graph concepts will be discussed	2 Problem modelling in Graphs for practice	1 Solutions using Graphs will be analysed	1 Usage of Graphs in various domains will be evaluated	2 Programming language to implement solutions will be taught	2 Application of data structures real-world problems			1 Assignments for solving real world problems using Data structures	1 Assignments Seminars on Content beyond syllabus will be given		

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO5:	Analyse and apply searching and sorting techniques for various applications											
	1 Fundamental concepts of Sorting & Searching will be discussed	2 Various problem domains for which Sorting and searching algorithms to be used will be discussed	2 Solutions using sorting and search algorithms will be analysed	2 Usage of different algorithms and their efficiency will be evaluated and compared for suitability	2 Programming language to implement solutions will be taught	2 Using appropriate sorting & Searching algorithms to solve real-time problems will be analysed			1 Assignments / Mini project for implementation of solution to real-time problems using Data structures and algorithms will be given	1 Assignments, Seminars on Content beyond syllabus will be given		

Writing COs

Blooms' Taxonomy levels –

- connects to learning required to answer questions in Exams.
- Bloom's Taxonomy is widely used in education to take students beyond simple memorization.

1. Knowledge/remembering (recall)
2. Comprehension/understanding.
3. Application/applying.
4. Analysis/analyzing.
5. Evaluation/evaluating.
6. Synthesis/creating.

Attaining POs requires reaching higher Bloom-level in T-L-A

Two useful study resources

EXAMINATION REFORM POLICY, NOVEMBER 2018

https://www.aicte-india.org/sites/default/files/ExaminationReforms.pdf

Model Question Papers for Undergraduate Programs

https://www.aicte-india.org/sites/default/files/MQP.pdf

Revised Bloom's taxonomy in the cognitive domain includes thinking, knowledge, and application of knowledge. It is a popular framework in engineering education to structure the assessment as it characterizes complexity and higher-order abilities. It identifies six levels of competencies within the **cognitive domain** which are appropriate for the purposes of engineering education.

According to revised Bloom's taxonomy, the levels in the cognitive domain are as follows:

Level	Descriptor	Level of attainment
1	Remembering	Recalling from the memory of the previously learned material
2	Understanding	Explaining ideas or concepts (**in ones own words with rigour and precision**)
3	Applying	Using the information in another familiar situation (**ability to generalise and expand**)
4	Analysing	Decomposing a system/information into parts and connections between them to explore understandings and relationships
5	Evaluating	Justifying a decision or course of action (**Pros and ons reasoning**)
6	Creating	Generating new ideas, products or new ways of viewing things **(out-of-the box thinking)**

Revised Bloom's Taxonomy

Bloom's taxonomy is hierarchical;
learning at higher level requires skills at a lower level to be attained

2. Action Verbs for Assessment

Choice of action verbs in constructing assessment questions is important to consider. Quite often, the action verbs are indicators of the complexity (level) of the question. Over time, educators have come up with a taxonomy of measurable verbs corresponding to each of the Bloom's cognitive levels.

These verbs help us not only to describe and classify observable knowledge, skills and abilities but also to frame the examination or assignment questions that are appropriate to the level we are trying to assess.

Suggestive list of skills/ competencies to be demonstrated at each of the Bloom's level and corresponding cues/ verbs for the examination/ test questions is given below:

Level	Skill Demonstrated	Question cues / Verbs for tests
1. Remember	• Ability to recall facts, conventions, definitions, jargon, technical terms, classifications, categories, and criteria • ability to recall methodology and procedures, abstractions, principles, and theories in the field • knowledge of dates, events, places • mastery of subject matter	list, define, tell, describe, recite, recall, identify, show, label, tabulate, quote, name, who, when, where

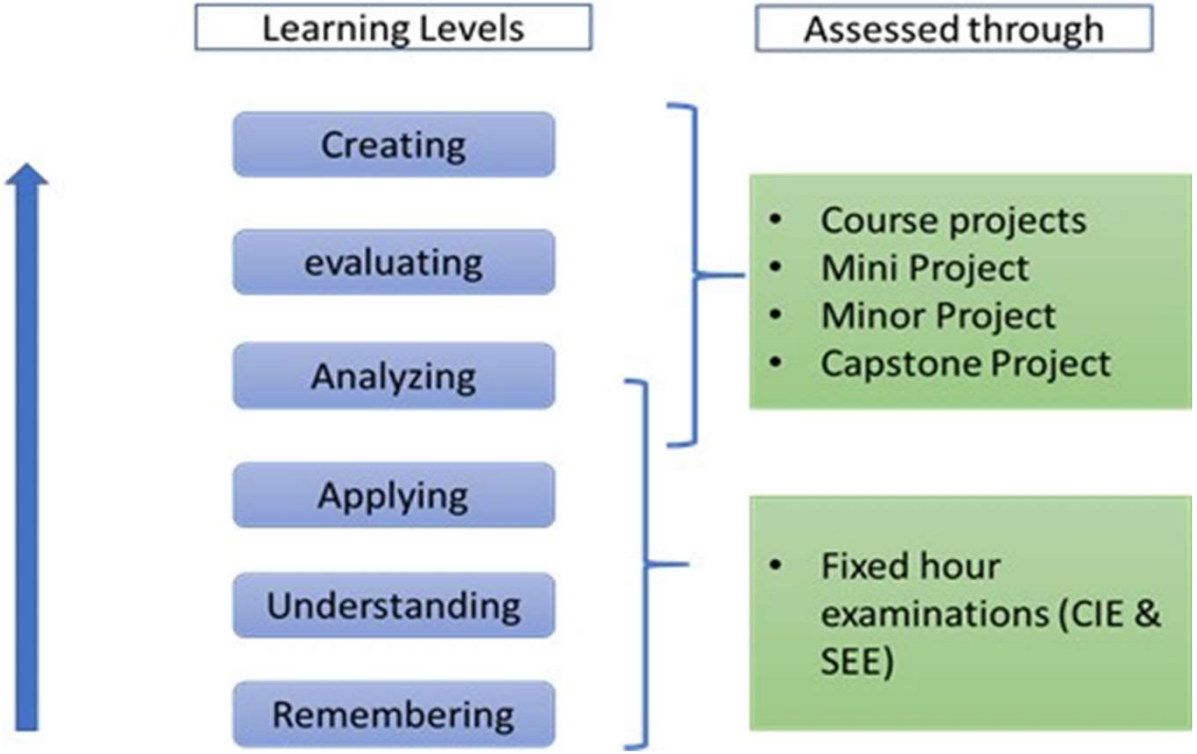
Level	Skill Demonstrated	Question cues / Verbs for tests
2. Understand	• understanding information • grasp meaning • translate knowledge into new context • interpret facts, compare, contrast • order, group, infer causes • predict consequences	describe, explain, paraphrase, restate, associate, contrast, summarize, differentiate interpret, discuss
3. Apply	• use information • use methods, concepts, laws, theories in new • situations • solve problems using required skills or knowledge • Demonstrating correct usage of a method or procedure	calculate, predict, apply, solve, illustrate, use, demonstrate, determine, model, experiment, show, examine, modify
4. Analyse	• break down a complex problem into parts • Identify the relationships and interaction between the • different parts of a complex problem • identify the missing information, sometimes the redundant information and the contradictory information, if any	classify, outline, break down, categorize, analyze, diagram, illustrate, infer, select

Level	Skill Demonstrated	Question cues / Verbs for tests
5. Evaluate	• compare and discriminate between ideas • assess value of theories, presentations • make choices based on reasoned argument • verify value of evidence • recognize subjectivity • use of definite criteria for judgments	assess, decide, choose, rank, grade, test, measure, defend, recommend, convince, select, judge, support, conclude, argue, justify, compare, summarize, evaluate
6. Create	• use old ideas to create new ones • Combine parts to make (new) whole, • generalize from given facts • relate knowledge from several areas • predict, draw conclusions	design, formulate, build, invent, create, compose, generate, derive, modify, develop, integrate

It may be noted that some of the verbs in the above table are associated with multiple Bloom's Taxonomy levels. These verbs are actions that could apply to different activities. We need to keep in mind that it is the skill, action or activity we need students to demonstrate that will determine the contextual meaning of the verb used in the assessment question.

3	Assessment Planning

Normally the first three learning levels; remembering, understanding and applying and to some extent fourth level analysing are assessed in the Continuous Internal Evaluation (CIE) and Semester End Examinations (SEE), where students are given a limited amount of time. And abilities; analysis, evaluation and creation can be assessed in extended course works or in a variety of student works like course projects, mini/ minor projects, internship experience and final year projects.



APPENDIX-A

Competencies and Performance Indicators (PIs)
Computer Science & Engineering/Information Technology Programs

	PO 1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation for the solution of complex engineering problems.

	Competency		Indicators
1.2	Demonstrate competence in mathematical modelling	1.2.1	Apply the knowledge of discrete structures, linear algebra, statistics and numerical techniques to solve problems
		1.2.2	Apply the concepts of probability, statistics and queuing theory in modeling of computer-based system, data and network protocols.
1.5	Demonstrate competence in basic sciences	1.5.1	Apply laws of natural science to an engineering problem

	Competency		Indicators
1.6	Demonstrate competence in engineering fundamentals	1.6.1	Apply engineering fundamentals
1.7	Demonstrate competence in specialized engineering knowledge to the program	1.7.1	Apply theory and principles of computer science and engineering to solve an engineering problem

APPENDIX-B

Sample questions for Bloom's Taxonomy levels

SAMPLES QUESTIONS FOR BLOOMS TAXONOMY LEVELS:

1. REMEMBER

Skill Demonstrated	Question Ques / Verbs for tests
• Ability to recall of information like, facts, conventions, definitions, jargon, technical terms, classifications, categories, and criteria • ability to recall methodology and procedures, abstractions, principles, and theories in the field • knowledge of dates, events, places • mastery of subject matter	list, define, describe, state, recite, recall, identify, show, label,tabulate, quote, name, who, when, where, etc.

Sample Questions:

1. State Ohm's law
2. List the physical and chemical properties of silicon
3. List the components of A/D converter
4. List the arithmetic operators available in C in increasing order of precedence.
5. Define the purpose of a constructor.
6. Define the terms: Sensible heat, Latent heat and Total heat of evaporation
7. List the assembler directives.
8. Describe the process of galvanisation and tinning

Sample Questions:

9. Write truth table and symbol of AND, OR, NOT, XNOR gates
10. Define the terms: Stress, Working stress and Factor of safety.
11. What is the difference between declaration and definition of a variable/function?
12. List the different storage class specifiers in C.
13. What is the use of local variables?
14. What is a pointer to a pointer?
15. What are the valid places for the keyword “break” to appear?
16. What is a self-referential structure?

2. UNDERSTAND

Skill Demonstrated	Question Ques / Verbs for tests
• understanding information • grasp meaning • translate knowledge into new context • interpret facts, compare, contrast • order, group, infer causes • predict consequences	describe, explain, paraphrase, restate, associate, contrast, summarize, differentiate interpret, discuss

Sample Questions:

1. Explain the importance of sustainability in Engineering design
2. Explain the behaviour of PN junction diode under different bias conditions
3. Describe the characteristics of SCR and transistor equivalent for a SCR
4. Explain the terms: Particle, Rigid body and Deformable body giving two examples for each.

Sample Questions:

5. How many values of the variable num must be used to completely test all branches of the following code fragment?

```
if (num>0)
      if (value<25)
{
       value=10*num;  if(num<12)
                        value=value/10;
}
     else
            Value=20*num;
 else
             Value=30*num
```

6. Discuss the effect of Make in India initiative on the Indian manufacturing Industry.
7. Summarise the importance of ethical code of conduct for engineering professionals
8. Explain the syntax for ‘for loop’.
9. What is the difference between including the header file with-in angular braces < > and double quotes “ ”?

Sample Questions:

10. What is the meaning of base address of the array?
11. What is the difference between actual and formal parameters?
12. Explain the different ways of passing parameters to the functions.
13. Explain the use of comma operator (,).
14. Differentiate between entry and exit controlled loops.
15. How is an array different from linked list?

3. APPLY

Skill Demonstrated	Question Ques / Verbs for tests
• use information • use methods, concepts, laws, theories in new situations • solve problems using required skills or knowledge • Demonstrating correct usage of a method or procedure	calculate, predict, apply, solve, illustrate, use, demonstrate, determine, model, experiment, show, examine, modify

Sample Questions:

1. Model and realize the following behaviors using diodes with minimum number of digital inputs.

   (i) Turning on of a burglar alarm only during night time when the locker door is opened.

   (ii) Providing access to an account if either date of birth or registered mobile number or both are correct.

   (iii) Updating the parking slot empty light in the basement of a shopping mall.

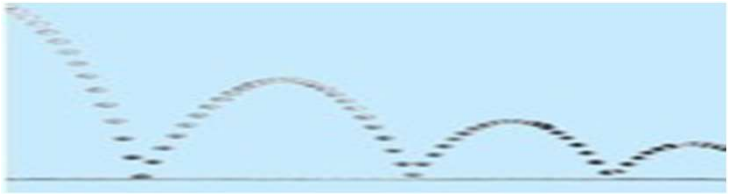
1. One of the resource persons needs to address a huge crowd (nearly 400 members) in the auditorium. A system is to be designed in such a way that everybody attending the session should be able to hear properly and clearly without any disturbance. Identify the suitable circuit to boost the voice signal and explain its functionality in brief.

Sample Questions:

3. A ladder 5.0 m long rests on a horizontal ground & leans against a smooth vertical wall at an angle 20^0 with the vertical. The weight of the ladder is 900 N and acts at its middle. The ladder is at the point of sliding, when a man weighing 750 N stands on a rung 1.5 m from the bottom of the ladder. Calculate the coefficient of friction between the ladder & the floor.

4. A ball is dropped from 6 meters above a flat surface. Each time the ball hits the surface after falling a distance h, it rebounds a distance rh. What will be the total distance the ball travels in each of the following cases.

(a) r>1 (b) 0<r<1 (c) r=1



5. The region bounded by the curves y=e^((-1)/x),y=0,x=1, and x=5 is rotated about the x-axis. Use Simpson's Rule with n=8 to estimate the volume of the resulting solid.

6. An electric train is powered by machine which takes the supply from 220 V DC rail running above the train throughout. Machine draws current of 100 A from the DC rail to account for high torque during starting and runs at 700 r.p.m initially. Calculate the new speed of the train once it picks up the speed where the torque output required is only 70% of starting torque. Assume the motor has a resistance of 0.1Ω across its terminals.

Sample Questions:

7. Write an algorithm to implement a stack using queue.
8. A single array A[1..MAXSIZE] is used to implement two stacks. The two stacks grow from opposite ends of the array. Variables top1 and top2 (topl< top2) point to the location of the topmost element in each of the stacks. What is the condition for “stack full”, if the space is to be used efficiently.
9. Consider the following table of arrival time and burst time for three processes P0, P1 and P2.

Process	Arrival Time	Burst Time
P0	0 ms	9 ms
P1	1 ms	4 ms
P2	2 ms	9 ms

   The pre-emptive shortest job first scheduling algorithm is used. Scheduling is carried out only at arrival or completion of processes. What is the average waiting time for the three processes?

10. A CPU generates 32-bit virtual addresses. The page size is 4 KB. The processor has a translation look- aside buffer (TLB) which can hold a total of 128-page table entries and is 4-way set associative. What is the minimum size of the TLB tag?

4. ANALYZE

Skill Demonstrated	Question Ques / Verbs for tests
• break down a complex problem into parts. • Identify the relationships and interaction between the • different parts of complex problem	classify, outline, break down, categorize, analyse, diagram, illustrate, infer, select

Sample Questions:

1. A class of 10 students consists of 5 males and 5 females. We intend to train a model based on their past scores to predict the future score. The average score of females is 60 whereas that of male is 80. The overall average of the class is 70. Give two ways of predicting the score and analyse them for fitting model.

2. Suppose that we want to select between two prediction models, M1 and M2. We have performed 10 rounds of 10-fold cross-validation on each model, whereas the same data partitioning in round one is used for both M1 and M2. The error rates obtained for M1 are 30.5, 32.2, 20.7, 20.6, 31.0, 41.0, 27.7, 26.0, 21.5, 26.0. The error rates for M2 are 22.4, 14.5, 22.4, 19.6, 20.7, 20.4, 22.1, 19.4, 16.2, 35.0. Comment on whether one model is significantly better than the other considering a significance level of 1%.

Sample Questions:

3. Return statement can only be used to return a single value. Can multiple values be returned from a function? Justify your answer.

4. Bob wrote a program using functions to find sum of two numbers whereas Alex wrote the statements to find the sum of two numbers in the main() function only. Which of the two methods is efficient in execution and why?

5. Carly wants to store the details of students studying in 1st year and later on wishes to retrieve the information about the students who score the highest marks in each subject. Specify the scenario where the data can be organized as a single 2-D array or as multiple 1-D arrays.

6. Dave is working on a Campus Management Software but is unable to identify the maximum number of students per course. He decided to implement the same using arrays but discovered that there is memory wastage due to over-provisioning. Which method of memory storage should be used by Dave and how it can be implemented using C?

Sample Questions:

7. Ram is working on a 32-bit machine whereas Sita is working on a 64-bit machine. Both wrote the same code to find factorial of a number but Ram is unable to find factorial of a number till 9 whereas Sita is able to find the factorial of higher number. Identify the possible reason why Ram is unable to find the factorial. Suggest some changes in the code so that Ram can handle bigger inputs.

8. While writing a C code, the problem faced by the programmers is to find if the parenthesis is balanced or not. Write an algorithm to check if the parenthesis in C code are balanced. Initially your code should work for balanced { and } braces.

9. Swapping of the data in a linked list can be performed by swapping the contents in the linked list. Can the contents of a linked list be swapped without actually swapping the data?

5. EVALUATE

Skill Demonstrated	Question Ques / Verbs for tests
• compare and discriminate between ideas • assess value of theories, presentations • make choices based on reasoned argument • verify value of evidence • recognize subjectivity • use of definite criteria for judgments	assess, decide, choose, rank, grade, test, measure, defend, recommend, convince, select, judge, support, conclude, argue, justify, compare, summarize, evaluate

6. CREATE

Skill Demonstrated	Question Ques / Verbs for tests
• use old ideas to create new ones • Combine parts to make (new) whole, • generalize from given facts • relate knowledge from several areas • predict, draw conclusions	design, formulate, build, invent, create, compose, generate, derive, modify, develop, integrate

Both higher order cognitive skills 'Evaluate' and 'Create' are difficult to assess in time-limited examinations. These need to be assessed in variety of student works like projects, open ended problem- solving exercises etc. Typical examples of problem statements or need statements which need higher order abilities to solve are given below

Sample Problem / Need statements:

1. Automatic tethering of milking machine to the udder of a cow. A milk diary wants to automate the milking process. The milking process involves attaching the milking cups to the teats. Design a system for the same.
2. An electric vehicle uses LIoN batteries. The batteries have to be charged and get discharged during use. The batteries require continuous monitoring during charging and discharging so that they remain healthy and yield a long life. Design a system to monitor and manage the health of the batteries.
3. A Biotech industry needs automation for filling its product into 20 ltr bottles. Design a system to meter the flow into the bottles so that each bottle has 20 ltr of the liquid. There will be more than one filling station and the system has to monitor all the filling stations as well as keep count of the total production on a daily basis.
4. Microwave Doppler radar with a range of 9m are available for motion detection. Design a surround view monitoring system for a 3 wheeler to detect human obstacles while the vehicle is in motion.
5. Design a system to assist the driver by using cameras to detect lane markers and pedestrians while the vehicle is in motion.
6. Develop a small size USB 2.0 / 3.0 CMOS camera system which can be used for industrial inspection, medical applications, microscopy, etc. The system should be able to capture the image quickly and be able to process the captured image and then store it also

APPENDIX-C

Model Question Papers

MODEL QUESTION PAPER

Course: Programming for Problem solving (ESC 103)

Maximum Marks :100; Duration: 03 hours

Q.No	Questions	Marks	CO	BL	PI
1(a)	Explain the steps involved in solving a problem using computer.	08	CO1	L2	1.4.1
1(b)	Write an algorithm to find roots of a quadratic equation ax2 + bx +c = 0 reading the values of a, b and c.	12	CO2	L3	1.4.1
2(a)	Compare if-else-if and switch statement giving examples for their relevant use.	08	CO2	L2	1.4.1
2b	Write a C program that reads a given integer number and checks whether it a palindrome. A palindrome is a number that has same value even when it is reversed. Eg: 12321 is a palindrome.	12	CO3	L3	1.4.1
3a	Compare the working of three looping constructs of C language giving their syntax.	08	CO3	L2	1.4.1

Q.No	Questions	Marks	CO	BL	PI

3b	What does the following program do? #include <stdio.h>
	int main()
	{
	char ch;
	int vcnt = 0, ccnt=0;
	for (ch = getchar(); ch != '\n'; ch=getchar()){
	if(ch=='a' || ch=='e' || ch=='i' || ch=='o' || ch=='u' || ch=='A' || ch=='E' ||
	ch=='I' || ch=='O' || ch=='U') vcnt++;
	else if((ch >= 'a' && ch <= 'z') || (ch >= 'A' && ch <= 'Z'))
	ccnt++;
	}
	printf(" %d %d\n", vcnt, ccnt);
	}
	Rewrite the above program using while and switch constructs.
		12	CO4	L4	1.4.1

4a	Compare call by value and call by reference with relevant examples.	8	CO3	L2	1.4.1

Q.No	Questions	Marks	CO	BL	PI
4b	Write a C function to find the largest and smallest in a given list of integers of size n using call by reference: void minmax(int list[ ], int n, int *min, int *max);	12	CO3	L3	1.4.1
5a	Explain at least four file handling operations available in C language giving their syntax.	4	CO3	L2	1.4.1
5b	Identify the bug in the following function written to return the swapped values of two integer variables given:				

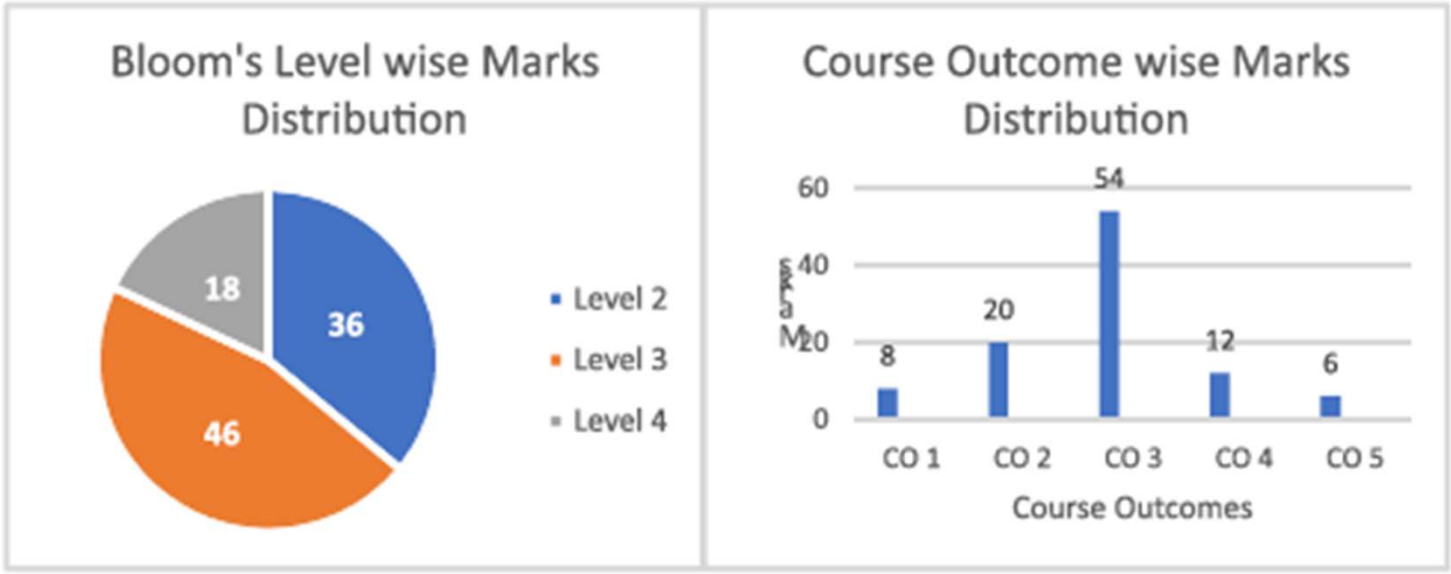
	int swap(int *x, int *y)
	{
	int *temp;
	temp = x, x=y, y = temp;
	}
		6	CO5	L4	1.4.1

5c	Define a structure to store time with three components hours, mins and seconds. Write a modular C program to compute the time taken by an athlete to complete a marathon reading the start and end time of his run.	10	CO3	L3	1.4.1

BL – Bloom's Taxonomy Levels (1- Remembering, 2- Understanding, 3 – Applying, 4 – Analysing, 5 – Evaluating, 6 - Creating)

CO – Course Outcomes

PO – Program Outcomes; PI Code – Performance Indicator Code



https://www.aicte-india.org/sites/default/files/ExaminationReforms.pdf

Examination Reform Policy

ALL INDIA COUNCIL FOR TECHNICAL EDUCATION

Nelson Mandela Marg, Vasant Kunj, New Delhi-110070

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ASSESSMENT STRATEGY
FOR OUTCOME-BASED EDUCATION

2 Two-step Process for Bringing Clarity to POs

- POs give useful guidance at the program level for the curriculum design, delivery and assessment of student learning. However, they represent fairly high-level generic goals that are not directly measurable. Real observability and measurability of the POs at course level is very difficult. To connect high-level learning outcomes (POs) with course content, course outcomes and assessment, there is a necessity to bring further clarity and specificity to the program outcomes [5]. This can be achieved through the following two-step process of identifying Competencies and Performance Indicators (PI).

- (1) Identify Competencies to be attained: For each PO define competencies –different abilities implied by program outcome statement that would generally require different assessment measures. This helps us to create a shared understanding of the competencies we want students to achieve. They serve as an intermediate step to the creation of measurable indicators.

Example: Program Outcome 3

Design:

PO3: Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.

Competencies

1. Demonstrate an ability to define a complex, open-ended problem in engineering terms.
2. Demonstrate an ability to generate a diverse set of alternative design solutions.
3. Demonstrate an ability to select the optimal design scheme for further development.
4. Demonstrate an ability to advance an engineering design to the defined end state.

(2) Define Performance Indicators: For each of the competencies identified, define performance Indicators (PIs) that are explicit statements of expectations of the student learning. They can act as measuring tools in assessment to understand the extent of attainment of outcomes. They can also be designed to determine the appropriate achievement level or competency of each indicator so that instructors can target and students can achieve the acceptable level of proficiency.

Example:

For the Competency -2

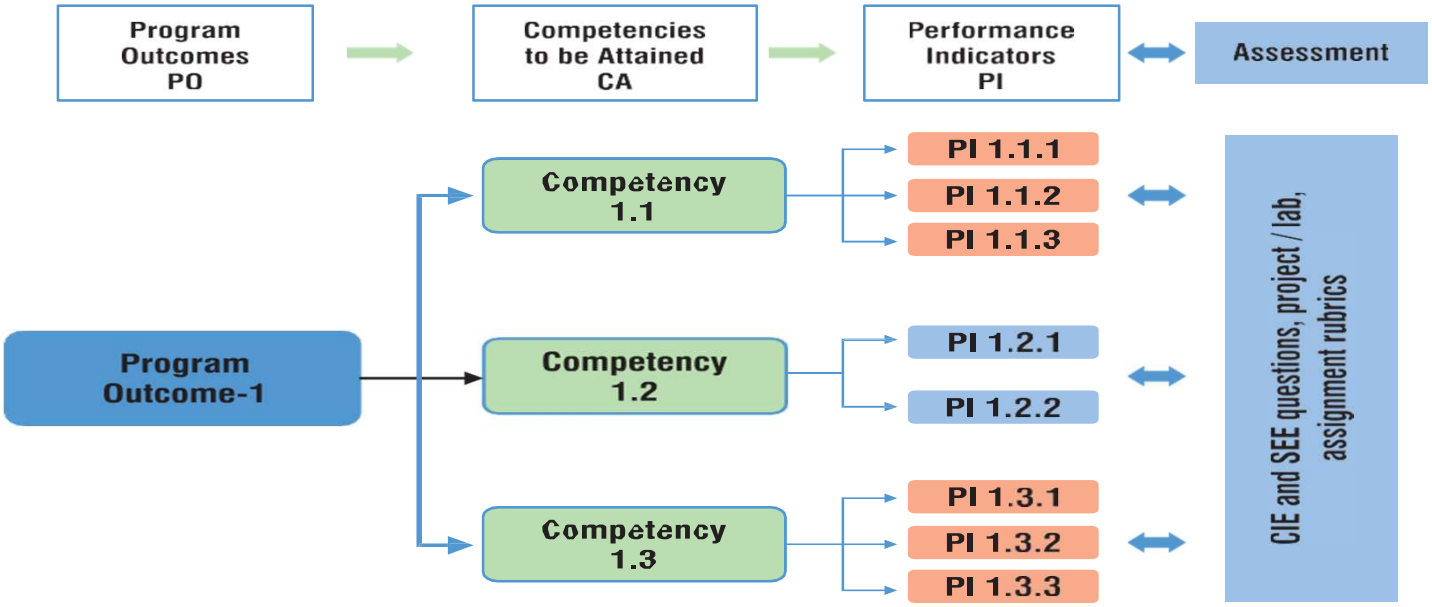
Demonstrate an ability to generate a diverse set of alternative design solutions

Performance Indicators:

1. Apply formal idea generation tools to develop multiple engineering design solutions
2. Build models, prototypes, algorithms to develop a diverse set of design solutions
3. Identify the functional and non-functional criteria for evaluation of alternate design solutions.

It should be noted that, when we consider the program outcome, it looks like, it can be achieved only in the Capstone project. But if we consider the competencies and performance indicators, we start seeing the opportunities of addressing them (and hence PO) in various courses of the program.

Once the above process is completed for the program, the assessment of COs for all the courses is designed by connecting assessment questions (used in various assessment tools) to the PIs. By following this process, where examination questions map with PIs, we get clarity and better resolution for the assessment of COs and POs. The pictorial representation of the process is given in Figure below:



Connecting POs to Assessment

3 Program Outcomes – Competencies – Performance Indicators

Following table gives the suggestive list of competencies and associated performance indicators for each of the PO in ***Mechanical Engineering Program***.

	PO 1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation for the solution of complex engineering problems.		
	Competency		**Indicators**
1.1	Demonstrate competence in mathematical modelling	1.1.1	Apply mathematical techniques such as calculus, linear algebra, and statistics to solve problems
		1.1.2	Apply advanced mathematical techniques to model and solve mechanical engineering problems
1.2	Demonstrate competence in basic sciences	1.2.1	Apply laws of natural science to an engineering problem
1.3	Demonstrate competence in engineering fundamentals	1.3.1	Apply fundamental engineering concepts to solve engineering problems
1.4	Demonstrate competence in specialized engineering knowledge to the program	1.4.1	Apply Mechanical engineering concepts to solve engineering problems.

	PO 2: Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.		
	Competency		**Indicators**
2.1	Demonstrate an ability to identify and formulate complex engineering problem	2.1.1	Articulate problem statements and identify objectives
		2.1.2	Identify engineering systems, variables, and parameters to solve the problems
		2.1.3	Identify the mathematical, engineering and other relevant knowledge that applies to a given problem
2.2	Demonstrate an ability to formulate a solution plan and methodology for an engineering problem	2.2.1	Reframe complex problems into interconnected sub-problems
		2.2.2	Identify, assemble and evaluate information and resources.
		2.2.3	Identify existing processes/solution methods for solving the problem, including forming justified approximations and assumptions
		2.2.4	Compare and contrast alternative solution processes to select the best process.

2.3	Demonstrate an ability to formulate and interpret a model	2.3.1	Combine scientific principles and engineering concepts to formulate model/s (mathematical or otherwise) of a system or process that is appropriate in terms of applicability and required accuracy.
		2.3.2	Identify assumptions (mathematical and physical) necessary to allow modeling of a system at the level of accuracy required.
2.4	Demonstrate an ability to execute a solution process and analyze results	2.4.1	Apply engineering mathematics and computations to solve mathematical models
		2.4.2	Produce and validate results through skilful use of contemporary engineering tools and models
		2.4.3	Identify sources of error in the solution process, and limitations of the solution.
		2.4.4	Extract desired understanding and conclusions consistent with objectives and limitations of the analysis

	PO 8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.		
	Competency		**Indicators**
8.1	Demonstrate an ability to recognize ethical dilemmas	8.1.1	Identify situations of unethical professional conduct and propose ethical alternatives
8.2	Demonstrate an ability to apply the Code of Ethics	8.2.1 8.2.2	Identify tenets of the ASME professional code of ethics Examine and apply moral & ethical principles to known case studies

	PO 10: Communication: Communicate effectively on complex engineering activities with the engineering community and with the society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions		
	Competency		**Indicators**
10.1	Demonstrate an ability to comprehend technical literature and document project work	10.1.1	Read, understand and interpret technical and non-technical information
		10.1.2	Produce clear, well-constructed, and well-supported written engineering documents
		10.1.3	Create flow in a document or presentation - a logical progression of ideas so that the main point is clear
10.2	Demonstrate competence in listening, speaking, and presentation	10.2.1	Listen to and comprehend information, instructions, and viewpoints of others
		10.2.2	Deliver effective oral presentations to technical and non-technical audiences
10.3	Demonstrate the ability to integrate different modes of communication	10.3.1	Create engineering-standard figures, reports and drawings to complement writing and presentations
		10.3.2	Use a variety of media effectively to convey a message in a document or a presentation

	PO 12: Life-long learning: Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.		
	Competency		**Indicators**
12.1	Demonstrate an ability to identify gaps in knowledge and a strategy to close these gaps	12.1.1	Describe the rationale for the requirement for continuing professional Development.
		12.1.2	Identify deficiencies or gaps in knowledge and demonstrate an ability to source information to close this gap.
12.2	Demonstrate an ability to identify changing trends in engineering knowledge and practice	12.2.1	Identify historic points of technological advance in engineering that required practitioners to seek education in order to stay current.
		12.2.2	Recognize the need and be able to clearly explain why it is vitally important to keep current regarding new developments in your field.

12.3	Demonstrate an ability to identify and access sources for new information	12.3.1	Source and comprehend technical literature and other credible sources of information.
		12.3.2	Analyze sourced technical and popular information for feasibility, viability, sustainability, etc.

- *The above table can be used for most of the engineering programs. However, for Computer Science &*
- *Engineering/ Information Technology programs it requires some modifications.*
- **A suggestive list of competencies and associated performance indicators for** Computer Science & Engineering/ Information Technology **Programs is given in Appendix- A.**

APPENDIX-D

Sample Scoring Rubrics

RUBRICS FOR COMMUNICATION (WRITTEN & ORAL)

Component	Proficient	Acceptable	Needs Improvements
Written Communication	Report is well organized and clearly written. The underlying logic is clearly articulated and easy to follow. Words are chosen that precisely express the intended meaning and support reader comprehension. Diagrams or analyses enhance and clarify presentation of ideas. Sentences are grammatical and free from spelling errors.	Report is organized and clearly written for the most part. In some areas the logic or flow of ideas is difficult to follow. Words are well chosen with some minor exceptions. Diagrams are consistent with the text. Sentences are mostly grammatical and only a few spelling errors are present but they do not hinder the reader.	Report lacks an overall organization. Reader has to make considerable effort to understand the underlying logic and flow of ideas. Diagrams are absent or inconsistent with the text. Grammatical and spelling errors make it difficult for the reader to interpret the text in places.
Presentation Visual Aids	Slides are error-free and logically present the main components of the process and recommendations. Material is readable and the graphics highlight and support the main ideas.	Slides are error-free and logically present the main components of the process and recommendations. Material is mostly readable and graphics reiterate the main ideas.	Slides contain errors and lack a logical progression. Major aspects of the analysis or recommendations are absent. Diagrams or graphics are absent or confuse the audience.

Component	Proficient	Acceptable	Needs Improvements
Oral Presentation	Speakers are audible and fluent on their topic, and do not rely on notes to present or respond. Speakers respond accurately and appropriately to audience questions and comments.	Speakers are mostly audible and fluent on their topic, and require minimal referral to notes. Speakers respond to most questions accurately and appropriately.	Speakers are often inaudible or hesitant, often speaking in incomplete sentences. Speakers rely heavily on notes. Speakers have difficulty responding clearly and accurately to audience questions.
Body Language	Body language, as indicated by appropriate and meaningful gestures (e.g., drawing hands inward to convey contraction, moving arms up to convey lift, etc.) eye contact with audience, and movement, demonstrates a high level of comfort and connection with the audience.	Body language, as indicated by a slight tendency to repetitive and distracting gestures (e.g., tapping a pen, wringing hands, waving arms, clenching fists, etc.) and breaking eye contact with audience, demonstrates a slight discomfort with the audience.	Body language, as indicated by frequent, repetitive and distracting gestures, little or no audience eye-contact, and /or stiff posture and movement, indicate a high degree of discomfort interacting with audience.

RUBRICS FOR ASSESSMENT OF DESIGN PROJECTS

Category	Needs Improvements	Acceptable	Proficient
Purpose of the Project	Does not clearly explain the intended outcome of the project or provides little information about the problem that was being solved, the need being met, or why the project was selected	Provides a description of the intended outcome of the project which includes information about the problem that was being solved or the need being met, and why the project was selected	Provides a detailed intended outcome of the project which includes information about the problem that was being solved or the need being met, and clearly articulates the reasons and decision-making process used to select the project
Research	Lacks awareness of similar work done by others in an unacceptable literary form	Reflects awareness of similar work done by others and presents it in an acceptable literary format	•Reflects thorough understanding of similar work done by others and presents it in an acceptable literary format
Choices	Lacks justification of choices with little or no references to functional, aesthetic, social, economic, or environmental considerations	Justifies choices made with reference to functional, aesthetic, social, economic, or environmental considerations	Demonstrates sophisticated justification of choices with reference to functional, aesthetic, social, economic, or environmental consideration

Category	Needs Improvements	Acceptable	Proficient
Alternative Designs	Only one design presented or clearly infeasible alternative given. Serious deficiencies in exploring and identifying alternative designs.	Alternative approaches identified to some degree.	Final design achieved after review of reasonable alternatives.
Application of Engineering Principles	No or erroneous application of engineering principles yielding unreasonable solution. Serious deficiencies in proper selection and use of engineering principles.	Effective application of engineering principles resulting in reasonable solution.	Critical selection and application of engineering principles ensuring reasonable results.
Final Design	Not capable of achieving desired objectives.	Design meets desired objectives.	Design meets or exceeds desired objectives.
Interpretation of Results	No or erroneous conclusions based on achieved results. Serious deficiencies in support for stated conclusions.	Sound conclusions reached based on achieved results.	Insightful, supported conclusions and recommendations.

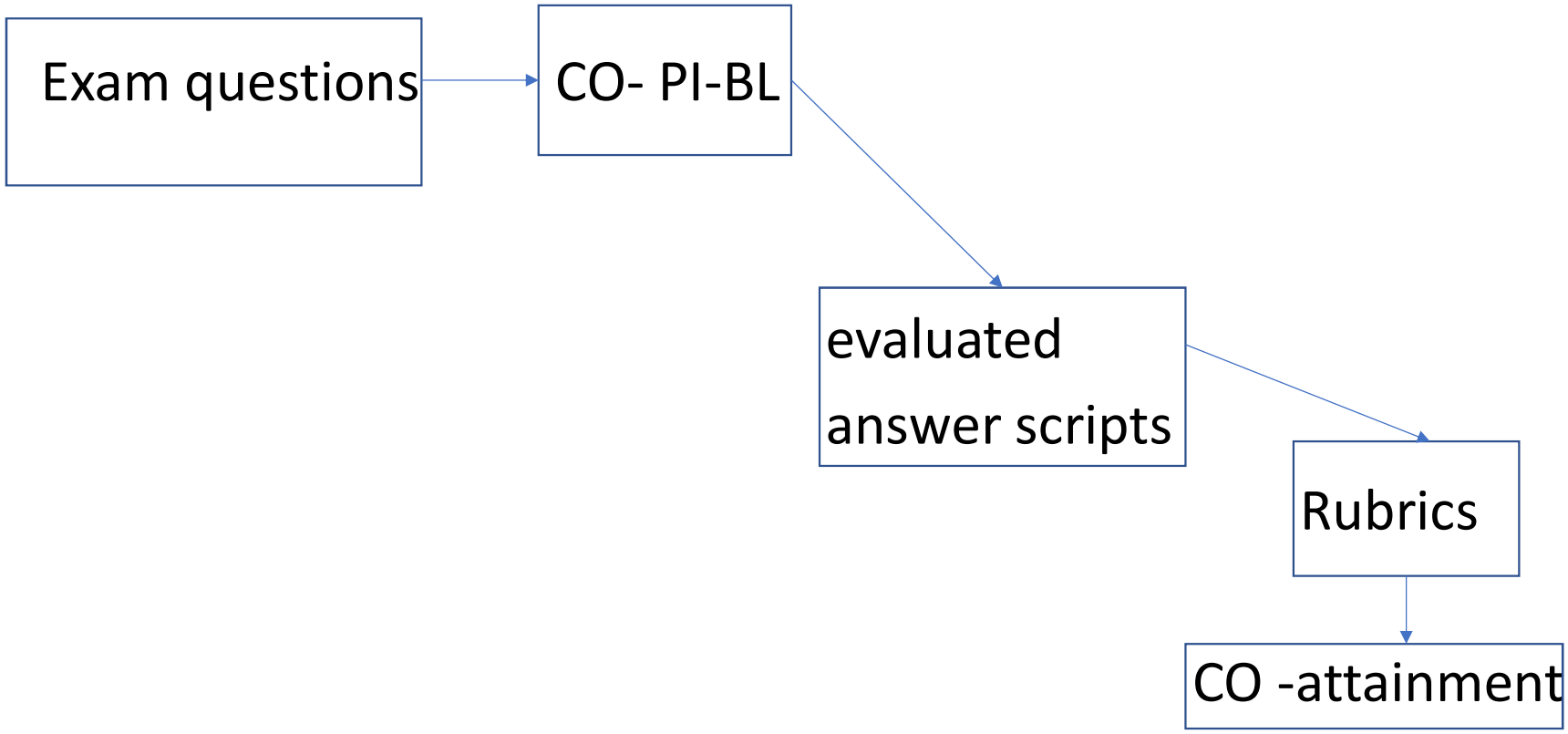
GA – Group Assessment IA – Individual Assessment

RUBRICS FOR REVIEW – III

PI Code	PI	Marks	Very Poor Up to 20%	Poor Up to 40%	Average Up to 60%	Good Up to 80%	Very good Up to 100%
10.2.2	Deliver effective oral presentations to technical and non- technical audiences - IA	03	Could not deliver effective presentations.	Could not deliver presentation, but presentation was prepared and attempted.	Able to deliver fair presentation but not able to answer to the audiences	Deliver effective presentations but able to answer partially to the audience queries.	Deliver effective presentation and able to answer all queries of the audience.
9.3.1	Present results as a team, with smooth integration of contributions from all individual efforts – GA + IA	03	No Contribution from an individual to a team	Contributions from an individual to a team is minimal	Contributions from an individual to a team is moderate	A contribution from an individual to a team is good but not well groomed in team.	Contribution from an individual to a team is good and results in an integrated team presentation.

GA – Group Assessment IA – Individual Assessment

Procedure for CO attainment calculation



CO attainment calculation

Reg no	Internal Exams																		University Exams						
	Test 1						Test 2						Models												
	CO1	CO2	CO3	CO4	CO5	Total	CO1	CO2	CO3	CO4	CO5	Total	CO1	CO2	CO3	CO4	CO5	Total	CO1	CO2	CO3	CO4	CO5	Interna	Total
16bcs01	30	40				70			20	30	25	75	17	18	15	9	15	74	9	6	20	13	20	24	92
16bsc02	25	37				62			25	25	25	75	18	14	8	11	9	60	8	7	15	14	19	23	86
16bsc03	10	30				40			14	20	25	59	19	13	11	15	11	69	7	8	20	10	18	21	84
16bsc04	14	20				24			10	17	24	51	20	15	17	14	15	81	6	4	11	5	15	17	58
No of students attended	4	4	4	4	4	4	4	4	4	4	4	4													
Max mark co wise	50	50	0	0	0	100	0	0	30	30	40	100	20	20	20	20	20	100	10	10	20	15	20	25	100
Threshold 50%	25	25				50			15	15	20	50	10	10	10	10	10	50	5	5	10	7.5	10	12.5	50
No of students above threshol	2	3				2			3	4	4	4	4	4	3	3	3	4	4	3	4	3	4	4	4
Level	**1**	**3**				**1**			**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

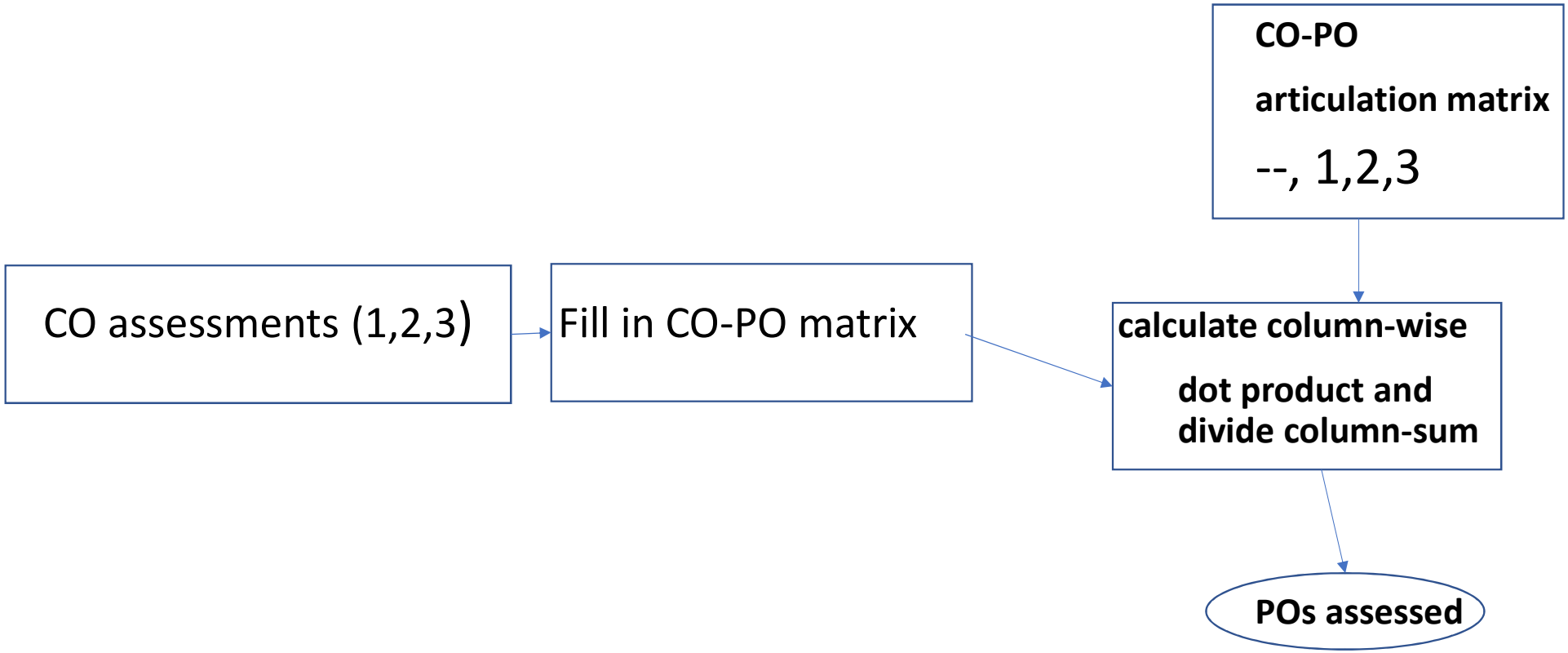
RUBRICS

50% OF STUDENT ABOVE 50% - 1 (LOW)

60% OF STUDENT ABOVE 50% - 2 (MEDIUM)

70% OF STUDENT ABOVE 50% - 3 (HIGH)

Procedure for PO attainment calculation



CO-PO mapping (example)

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) : blank: no correlation

						PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
SEM		**SUB CODE**	Course	**COURSE OUTCOMES**	**COURSE OUTCOMES Statement**												
III	**C203**	**BEXX201**	**Course name**	**C203.1**	.	3	3	2	2	-	-	3	3	2	2	1	-
				C203.2		-	-	-	-	-	-	3	3	3	2	1	-
				C203.3		-	-	-	-	-	-	3	2	2	2	1	-
				C203.4		-	-	-	-	-	-	3	2	2	2	1	-
				C203.5		-	-	-	-	-	-	2	2	2	2	1	-
				C203.6		-	-	-	-	-	-	2	2	2	2	1	-

PO Attainment - Calculation

Course	COs	Attainment Level Column A	PO1 Ccolumn B	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C3 01	C301.1	1.5	1	1	3	2	2	1	-	1	1	-	-	-	2	2	1
	C301.2	2.1	1	1	3	2	3	1	-	-	1	-	-	-	2	2	1
	C301.3	2.4	1	1	3	3	3	-	-	-	1	2	-	-	3	3	1
	C301.4	2.5	1	1	3	3	3	2	-	-	1	-	-	-	3	3	1
	C301.5	2.4	1	2	3	3	3	-	-	1	1	-	-	1	3	3	1
	C301.6	2.7	1	2	3	3	3	2	-	-	1	2	-	1	3	3	1
C3 02	C302.1	1.8	-	-	-	-	-	-	1	-	2	1	3	-	-	-	-
	C302.2	1.9	-	-	-	-	-	-	1	-	2	-	3	-	-	-	-
	C302.3	1.7	-	-	-	-	-	-	1	-	2	-	3	-	-	-	-
	C302.4	2.7	-	-	-	-	-	-	1	-	2	-	3	-	-	-	-
	C302.5	2.1	-	-	-	-	-	-	1	-	2	-	3	-	-	-	-
	C302.6	1.4	-	-	-	-	-	-	1	-	2	-	3	-	-	-	-
		Program Outcome Attainmen t	2.27	2.34	2.27	2.33	2.31	2.33	1.93	1.95	2.04	2.40	1.93	2.55	2.33	2.33	2.27

Here only 2 course are taken; for actual calculations all courses to be taken
Calculation: PO1= (column A* Column B)/Sum(column B)
This can be done in excel or spread-sheet tool

Using outcome assessment for improvement – an example

From an SAR of civil Engineering program (accreditation completed)

PO1: Engineering knowledge: Apply knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.

Target: 2.5 Set by Department; Calculated attainment: 2.3

The overall attainment of PO1 is near but below the target value;

The foundation course Mechanics of Materials (CVC202) has CO attainment below the target. Mathematical courses - Statistics and Integral Transforms (MAC209) and Numerical Methods and Partial Differential Equations (MAC213) have attainment below the target value. These are impacting the PO attainment.

Actions identified are – on the next slide

outcome assessment → improvement – example contd..

This diagnosis indicates insufficient connectivity between the theoretical concepts and their mathematical applications.

- Action 1: Contextual learning pedagogy is used in Mechanics of Materials (15ECVF202) to associate classroom teaching to real-world experiences and improve the grasp of fundamental concepts.
- Action 2: Mathematical courses in the third semester, i.e., Statistics and Integral Transforms (15EMAB202), and in the fourth semester, i.e., Numerical Methods and Partial Differential Equations (15EMAB207) introduced contextual problems of civil engineering.

When targets are achieved then outcomes are attained; subsequently,

We revise and set higher targets as a part of continuous improvement

Target setting and CI are go together in OBE

Recap

1. What is CO and PO/PSO?
2. CO->PO mapping and justification for the mapping entries
3. PO → Competency → Performance Indicators (PIs)
4. BLOOM LEVELS, Question -> [CO PI BL] /Rubrics
5. How to calculate CO attainment? Choice of thresholds
6. How to calculate PO attainment?
7. Close the loop – continuous improvement.

PRACTICE OF OBE

OVERVIEW

1. AS-IS: some observations on how we are doing it at present

2. SAR STRUCTURE: criteria and Marks

3. SAR CONTENTS: Data and its use, process description and application, Continuous Improvement (CI)

4. TO-BE some guidelines for making SAR and for the visit

OBE PRACTICE: AS-IS

- Working in spurts
- lack of being systematic in data discipline
- lack of cohesion in team work
- Few do and that too in parts, only prior to submission
- Everyone does not go through SAR
- Too much printing prior to the NBA team visit
- In brief, OBE is not fully integrated into the Academic System

SAR Structure

SAR structure:

PART-A (Institutional Information) and

PART-B (Program Specific Information)

10 criteria with marks.

Criteria have sub and sub-sub criteria

Preparation for the visit

- Study SAR critically. Look through the website and the evaluation guidelines. Note CAY, CAYm1and CAYm2as applicable.
- Prepare the pre-visit report, highlighting critical issues in the crireria to go into detail during the visit.
- Have questions on which to seek clarifications and/or obtain details ready, preferably written down.
- Look through data in PQ and correspond in SAR with the applicable years

Criteria Summary

Name of the program _____

Criteria No.	Criteria	Mark/Weightage
	Program Level Criteria	
1.	Vision, Mission and Program Educational Objectives	60
2.	Program Curriculum and Teaching –Learning Processes	120
3.	Course Outcomes and Program Outcomes	120
4.	Students' Performance	150
5.	Faculty Information and Contributions	200
6.	Facilities and Technical Support	80
7.	Continuous Improvement	50
	Institute Level Criteria	
8.	First Year Academics	50
9.	Student Support Systems	50
10.	Governance, Institutional Support and Financial Resources	120
	Total	1000

CRITERION 3	Course Outcomes and Program Outcomes	120

3.1. Establish the correlation between the courses and the Program Outcomes (POs) & Program Specific Outcomes (20)

(Program Outcomes as mentioned in Annexure I and Program Specific Outcomes as defined by the Program)

3.1.1. Course Outcomes (COs) (SAR should include course outcomes of one course from each semester of study, however, should be prepared for all courses and made available as evidence, if asked) (05)

Note: Number of Outcomes for a Course is expected to be around 6.

Course Name: Ciii Year of Study: YYYY – YY; for ex. C202 Year of study 2013-14

C202.1	**<Statement>**
C202.2	<Statement>
C202.3	<Statement>
…	<Statement>
C202.N	<Statement>

C202 is the second course in second year and '.1' to '.6' are the outcomes of this course

3.1.2. CO-PO matrices of courses selected in 3.1.1 (six matrices to be mentioned; one per semester from 3rd to 8th semester) (05)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C202.1												
C202.2												
C202.3												
…												
C202.N												
C202												

Note:

Enter correlation levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

It there is no correlation, put "-"

2. Similar table is to be prepared for PSOs

3.1.3. Program level Course-PO matrix of all courses INCLUDING first year courses (10)

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C101												
C202												
C303												
….												
….												
C4…												

Note:

Enter correlation levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

It there is no correlation, put "-"

* It may be noted that contents of Table 3.1.2 must be consistent with information available in Table 3.1.3 for all the courses.

2. *Similar table is to be prepared for PSOs*

3.2. Attainment of Course Outcomes (50)

3.2.1. Describe the assessment processes used to gather the data upon which the evaluation of Course Outcome is based (10)

(Examples of data collection processes may include, but are not limited to, specific exam/tutorial questions, assignments, laboratory tests, project evaluation, student portfolios (A portfolio is a collection of artifacts that demonstrate skills, personal characteristics and accomplishments created by the student during study period), internally developed assessment exams, project presentations, oral exams etc.)

3.2.2. Record the attainment of Course Outcomes of all courses with respect to set attainment levels (40)

Program shall have set Course Outcome attainment levels for all courses.
(The attainment levels shall be set considering average performance levels in the university examination or any higher value set as target for the assessment years. Attainment level is to be measured in terms of student performance in internal assessments with respect to the Course Outcomes of a course in addition to the performance in the University examination)

Measuring Course Outcomes attained through University Examinations

Target may be stated in terms of percentage of students getting more than the university average marks or more as selected by the Program in the final examination. For cases where the university does not provide useful indicators like average or median marks etc., the program may choose an attainment level on its own with justification.

For Example related to attainment levels Vs. targets: (The examples indicated are for reference only. Program may appropriately define levels), Please refer SAR

3.3. Attainment of Program Outcomes and Program Specific Outcomes (50)

3.3.1. Describe assessment tools and processes used for measuring the attainment of each Program Outcome and Program Specific Outcomes (10)

(Describe the assessment tools and processes used to gather the data upon which the evaluation of each of the Program Outcomes and Program Specific Outcomes is based indicating the frequency with which these processes are carried out. Describe the assessment processes that demonstrate the degree to which the Program Outcomes and Program Specific Outcomes are attained and document the attainment levels)

3.3.2. Provide results of evaluation of each PO & PSO (40)

(The attainment levels by direct (student performance) and indirect (surveys) are to be presented through Program level Course-PO&PSO matrices as indicated).

PO Attainment

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C101												
C102												
…												
…												
C409												
Direct Attainment												

Survey	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Survey 1												
Survey 2												
Survey 3												
…..												
Indirect Attainment												

Note: *Similar table is to be prepared for PSOs*
C101, C102 are indicative courses in the first year. Similarly, C409 is final year course. First numeric digit indicates year of study and remaining two digits indicate course nos. in the respective year of study.
• Direct attainment level of a PO & PSO is determined by taking average across all courses addressing that PO and/or PSO. Fractional numbers may be used for example 1.55.
• Indirect attainment level of PO & PSO is determined based on the student exit surveys, employer surveys, co-curricular activities, extracurricular activities etc.
Example:
It is assumed that a particular PO has been mapped to four courses C2O1, C3O2, C3O3 and C4O1
The attainment level for each of the four courses will be as per the examples shown in 3.2.2
PO attainment level will be based on attainment levels of direct assessment and indirect assessment
For affiliated, non-autonomous colleges, it is assumed that while deciding on overall attainment level 80% weightage may be given to direct assessment and 20% weightage to indirect assessment through surveys from students(largely), employers (to some extent). Program may have different weightages with appropriate justification.
Assuming following actual attainment levels:

Direct Assessment
C201 –High (3)
C302 – Medium (2)
C303 – Low (1)
C401 – High (3)
Attainment level will be summation of levels divided by no. of courses 3+2+1+3/4= 9/4=2.25
Indirect Assessment
Surveys, Analysis, customized to an average value as per levels 1, 2 & 3.
Assumed level - 2
PO Attainment level will be 80% of direct assessment + 20% of indirect assessment i.e. 1.8 + 0.4 = 2.2.
Note: Similarly for PSOs

Capsule view of SAR contents

SAR has data for 3 years CAY, CAYm1, CAYm2 (in a few places for 4 years)

list of equipment in labs **criterion 6**, faculty information, faculty publications,

criterion 5, student performance, placement **criterion 4**

SAR describes processes (e.g. how Vision/Mission are made, stake holder

involvement, how CO, PO attainment are calculated)

SAR has calculations, e.g. SFR, FSFR, CO, PO attainment, Expenditure per student,

calculation by peer visit committee provides scoring with justifications in writing - the scoring may differ from that of the institution/program as given in SAR

what to look for in SAR/website and during the visit

- Clean, good course files – must include question papers, Answer keys or rubrics, result analysis, CO-attainment
- CO->PO mapping - justification in terms of implementation
- How were thresholds/rubrics arrived at for CO/PO attainment calculations?
- Use of tools – spread sheets are helpful – saves time, can vary parameters (for example, thresholds) and analyse
- Incremental maintenance/updates of data at department/program/institution level on ongoing, continuous basis
- Efforts toward complex problem solving - higher Bloom-level Questions (HOTS) in assessments
- Faculty awareness and depth of understanding of the SAR

what to look for in SAR/website and during the visit (contd..)

- Adherence to timings and format for Institute and Department presentations
- Following Standards, e.g. listing of faculty publications
- Use digital records where applicable – view on projector
- Sharing of good practices, especially, internally.
- pedagogical approaches – evidences and exaggerations, if any?
- Curriculum revision – process, description
- Improvements in T-L-A

Evaluation Guidelines
with
indicative exhibits/context
to be Observed/Assessed

SAR Tier – I (UG Engineering)

Criterion 1: Vision, Mission and Program Educational Objectives (50)

Sub Criteria	Marks	Evaluation Guidelines
1.1.State the Vision and Mission of the Department and Institute	05	A. Availability of the Vision & Mission statements of the Department (1) B. Appropriateness/Relevance of the Statements (2) C. Consistency of the Department statements with the Institute statements (2) (Here Institute Vision and Mission statements have been asked to ensure consistency with the department Vision and Mission statements; the assessment of the Institute Vision and Mission will be done in Criterion 10)
Exhibits/Context to be Observed/Assessed: *A. Vision & Mission Statements B. Correctness from definition perspective C. Consistency between Institute and Department statements*		
1.2.State the Program Educational Objectives (PEOs)	05	A. Listing of the Program Educational Objectives (3 to 5) of the program under consideration (5)
Exhibits/Context to be Observed/Assessed: *A. Availability & correctness of the PEOs statements*		
1.3. Indicate where and how the Vision, Mission and PEOs are published and disseminated among stakeholders	15	A. Adequacy in respect of publication & dissemination (3) B. Process of dissemination among stakeholders (3) C. Extent of awareness of Vision, Mission & PEOs among the stakeholder (9)
Exhibits/Context to be Observed/Assessed: ***A.Adequacy*** *Department Vision, Mission and PEOs: Availability on Institute website under relevant program link; Availability at department notice boards, HoD Chamber, department website, if Available; Availability in department level documents/course of study* ***B. Process of dissemination*** *Documentary evidence to indicate the process which ensures awareness among internal and external stakeholders with effective process implementation* ***C. Extent of Awareness*** *Based on interaction with internal and external stakeholders*		

Sub Criteria	Marks	Evaluation Guidelines
1.4. State the process for defining the Vision and Mission of the Department, and PEOs of the program	15	A. Description of process involved in defining the Vision, Mission of the Department (7) B. Description of process involved in defining the PEOs of the program (8)
Exhibits/Context to be Observed/Assessed: *Documentary evidence to indicate the process which ensures effective participation of internal and external department stakeholders with effective process implementation.*		
1.5. Establish consistency of PEOs with Mission of the Department	10	A. Preparation of a matrix of PEOs and elements of Mission statement (5) B. Consistency/justification of co-relation parameters of the above matrix (5)
Exhibits/Context to be Observed/Assessed: *A. Availability of a matrix having PEOs and Mission elements B. Justification for each of the elements mapped in the matrix*		
Total:	**50**	

Criterion 2: Program Curriculum and Teaching–Learning Processes (100)

Sub Criteria	Marks	Evaluation Guidelines
2.1. Program Curriculum	30	
2.1.1. State the process for designing the program curriculum	10	Process used to demonstrate how the program curriculum is evolved and periodically reviewed considering the POs and PSOs. Also consider the involvement of the Industry.
Exhibits/Context to be Observed/Assessed: *Documentary evidence to indicate the process which demonstrate how the program curriculum is evolved and periodically reviewed considering the POs and PSOs.*		
2.1.2. Structure of the Curriculum	05	**Refer to SAR: Expectation in 2.1.2 & 2.1.3 is that the curriculum is well balanced structure & appropriate for a degree program.**
Exhibits/Context to be Observed/Assessed:		
2.1.3.State the components of the curriculum	05	Refer to SAR: Expectation in 2.1.2 & 2.1.3 is that the curriculum is well balanced structure & appropriate for a degree program
Exhibits/Context to be Observed/Assessed: *Documentary evidence*		
2.1.4. State the process used to identify extent of compliance of the curriculum for attaining the Program Outcomes(POs) & Program Specific Outcomes(PSOs)	10	Process used to identify extent of compliance of curriculum for attaining POs & PSOs (10)
Exhibits/Context to be Observed/Assessed: *Documentary evidence to indicate the process which ensures mapping/compliance of Curriculum with the POs & PSOs.*		

<table>
<tr><td>2.2. Teaching-Learning Processes</td><td>70</td><td></td></tr>
<tr><td>2.2.1. Describe the Process followed to improve quality of Teaching Learning</td><td>15</td><td>A. Adherence to Academic Calendar (2)
B. Pedagogical initiatives (2)
C. Methodologies to support weak students and encourage bright students(2)
D. Quality of classroom teaching (Observation in a Class) (2)
E. Conduct of experiments (Observation in Lab) (2)
F. Continuous Assessment in the laboratory (3)
G. Student feedback of teaching learning process and actions taken (2)</td></tr>
<tr><td colspan="3">Exhibits/Context to be Observed/Assessed:
A. Availability of Academic Calendar based on University academic calendar and its effective compliance
B. Documentary evidence to support implementation of pedagogical initiatives such as real life examples, collaborative learning, ICT supported learning, interactive class rooms etc.
C. Guidelines to identify weak and bright students; post identification actions taken; impact observed
D. Class room ambience; efforts to keep students engaged (also to be verified during interaction with the students)
E. Quality of laboratory experience with respect to conducting, recording observations, analysis etc.(also to be verified during interaction with the students)
F. Internal Semester examination and internal marks thereof, Practical record books, each experiment assessment, final marks based on assessment of all the experiments and other assessments; if any
G. Feedback format, frequency, analysis and actions taken (also to be verified during interaction with students)</td></tr>
<tr><td>2.2.2. Quality of end semester examination, internal semester question papers, assignments and evaluation</td><td>15</td><td>A. Process for internal semester question paper setting and evaluation and effective process implementation (3)
B. Process to ensure questions from outcomes/learning levels perspective (2)
C. Evidence of COs coverage in class test / mid-term tests (5)
D. Quality of Assignment and its relevance to COs (5)</td></tr>
<tr><td colspan="3">Exhibits/Context to be Observed/Assessed:
A. Process of internal semester question paper setting, model answers, evaluation and its compliance
B. Question paper validation to ensure desired standard from outcome attainment perspective as well as learning levels perspective
C. Mapping of questions with the Course outcomes
D. Assignments to promote self-learning, survey of contents from multiple sources, assignment evaluation and feedback to the students, mapping with the Cos</td></tr>
</table>

2.2.3. Quality of student projects	**20**	A. Identification of projects and allocation methodology to Faculty Members (2) B. Types and relevance of the projects and their contribution towards attainment of POs and PSOs (2) C. Project related to Industry (3) D. Process for monitoring and evaluation (2) E. Process to assess individual and team performance (3) F. Quality of completed projects/working prototypes (5) G. Evidences of papers published /Awards received by projects etc. (3)
Exhibits/Context to be Observed/Assessed: *A. Projects identification and guide allocation Process* *B. Projects classification (application, product, research, review etc.) consideration to factors such as environment, safety, ethics, cost, standards and mapping with program outcomes and program specific outcomes* *C. Continuous monitoring mechanism and evaluation* *D. Methodology(Appropriately documented) to assess individual contribution/understanding of the project as well as collective contribution/understanding* *E. Based on Projects demonstration* *F. Quality of place (host) where the paper has been published /quality of competition in which award has been won*		
2.2.4. Initiatives related to industry interaction	**10**	A. Industry supported laboratories (2) B. Industry involvement in the program design and Curriculum. (3) C. Industry involvement in partial delivery of any regular courses for students (3) D. Impact analysis of industry institute interaction and actions taken thereof (2)
Exhibits/Context to be Observed/Assessed: *A. Type of Industries, Type of Labs, objectives, utilization and effectiveness* *B. Documentary evidence* *C. Analysis and actions taken thereof*		
2.2.5. Initiatives related to industry internship/summer training	10	A. Industrial training/tours for students (2) B. Industrial /internship /summer training of more than two weeks and post training Assessment (3) C. Impact analysis of industrial training (2) D. Student feedback on initiative (3)
Exhibits/Context to be Observed/Assessed: (Documentary evidence from A to D) *A. & B. Type of Industries, planned or non-planned activity, objectives clearly defined, no. of students participated, relevant area of training, visit report documented* *C.& D. Impact analysis and feedback format, analysis and actions taken (also to be verified during interaction with students)*		
Total:	**100**	

Criterion 3: Course Outcomes and Program Outcomes (175)

Sub Criteria	Marks	Evaluation Guidelines
3.1. Establish the correlation between the courses and the POs & PSOs	25	A. Evidence of COs being defined for every course (5) B. Availability of COs embedded in the syllabi (5) C. Explanation of Course Articulation Matrix table to be ascertained (5) D. Explanation of Program Articulation Matrix tables to be ascertained (10)
Exhibits/Context to be Observed/Assessed: A. *Appropriateness of the statements shall be seen for atleast one course each from 2nd, 3rd and final year of study* B. *Mapping to be verified for atleast two matrices* C. *Mapping to be verified for atleast one course per year of study; program outcomes and program specific outcomes getting mapped with the core courses are also to be verified*		
3.2. Attainment of Course Outcomes	75	
3.2.1. Describe the assessment tools and processes used to gather the data upon which the evaluation of Course Outcome is based	10	A. List of assessment processes (2) B. The quality /relevance of assessment processes & tools used (8)
Exhibits/Context to be Observed/Assessed: *A.& B. Evidence for appropriate assessment processes including data collection, verification, analysis, decision making*		
3.2.2. Record the attainment of Course Outcomes of all courses with respect to set attainment levels	65	A. Verify the attainment levels as per the benchmark set for all courses (65)
Exhibits/Context to be Observed/Assessed: *A. Methodology to define set levels and its compliance; data collection, verification, analysis and decision making; details for one course per year of study to be verified*		

3.3. Attainment of Program Outcomes and Program Specific Outcomes	**75**	
3.3.1. Describe assessment tools and processes used for assessing the attainment of each of the POs & PSOs	10	A. List of assessment tools & processes (5) B. The quality/relevance of assessment tools/processes used (5)
Exhibits/Context to be Observed/Assessed: A.&B. Direct and indirect assessment tools & processes ; effective compliance; direct assessment methodology, indirect assessment formats-collection- analysis; decision making based on direct and indirect assessment		
3.3.2. Provide results of evaluation of each PO & PSO	65	A. Verification of documents, results and level of attainment of each PO/PSO (50) B. Overall levels of attainment (15)
Exhibits/Context to be Observed/Assessed: A. & B. Appropriate attainment level and documentary evidences; details for POs & PSOs attainment from core courses to be verified. Also atleast two POs & two PSOs attainment levels shall be verified		
Total	**175**	

Criterion 4: Students' Performance (100)

Sub Criteria	Marks	Evaluation Guidelines
4.1. Enrolment Ratio (20)	20	A. >= 90% students enrolled at the First Year Level on average basis during the previous three academic years starting from current academic year (20) B. >= 80% students enrolled at the First Year Level on average basis during the previous three academic years starting from current academic year (18) C. >= 70% students enrolled at the First Year Level on average basis during the previous three academic years starting from current academic year (16) D. >= 60% students enrolled at the First Year Level on average basis during the previous three academic years starting from current academic year (14) E. Otherwise '0'.
Exhibits/Context to be Observed/Assessed: *A. B. & C. Data to be verified for each of the assessment years*		
4.2. Success Rate in the stipulated period of the program	20	
4.2.1. Success rate without backlog in any Semester/year of study **Without Backlog means: No repeat(s) in any course in any semester/year of study**	15	SI= (Number of students who graduated from the program without repeat(s) in any course)/(Number of students admitted in the first year of that batch and actually admitted in 2nd year via lateral entry and separate division, if applicable) Average SI = Mean of success index (SI) for past three batches Success rate without backlogs in any year of study = 15 × Average SI
Exhibits/Context to be Observed/Assessed: *Data to be verified for each of the assessment years*		
4.2.2. Success rate in stipulated period (actual duration of the program) [Total of with backlog + without backlog]	5	SI= (Number of students who graduated from the program in the stipulated period of course duration)/(Number of students admitted in the first year of that batch and actually admitted in 2nd year via lateral entry and separate division, if applicable) Average SI = mean of success index (SI) for past three batches Success rate = 5 × Average SI
Exhibits/Context to be Observed/Assessed: Data to be verified for each of the assessment years Note: if 100% students clear without any backlog then also total marks scored will be 40 as both 4.2.1 & 4.2.2 will be applicable simultaneously.		

4.3. Academic Performance in Second Year	10	Academic Performance Level = Average API (Academic Performance Index) API = ((Mean of 2nd Year Grade Point Average of all successful Students on a 10 point scale) or (Mean of the percentage of marks of all successful student sin Second Year/10)) x (successful students/number of students appeared in the examination) Successful students are those who are permitted to proceed to the Third year
Exhibits/Context to be Observed/Assessed: *Data to be verified for at least one of the assessment years*		
4.4. Placement, Higher studies and Entrepreneurship	30	Assessment Points = 30 × average of three years of [(x + y + z)/N] where, x = Number of students placed in companies or Government sector through on/off campus recruitment y = Number of students admitted to higher studies with valid qualifying scores (GATE or equivalent State or National level tests, GRE, GMAT etc.) z = No. of students turned entrepreneur in engineering/technology N =Total number of final year students
Exhibits/Context to be Observed/Assessed: *Data to be verified for atleast one of the assessment years*		
4.5. Professional Activities	20	
4.5.1. Professional societies / chapters and organizing engineering events	05	A. Availability & activities of professional societies/chapters (3) B. Number, quality of engineering events (organized at institute) (2) (Level - Institute/State/National/International)
Exhibits/Context to be Observed/Assessed: *Self-Explanatory*		
4.5.2. Publication of technical magazines, newsletters, etc.	05	A. Quality & Relevance of the contents and Print Material (3) B. Participation of Students from the program (2)
Exhibits/Context to be Observed/Assessed: *A. Documentary evidence* *B. Documentary evidence - Students participation (also to be confirmed during interaction with the students)*		
4.5.3. Participation in inter-institute events by students of the program of study (at other institutions)	10	A. Events within the state (2) B. Events outside the state (3) C. Prizes/awards received in such events (5)
Exhibits/Context to be Observed/Assessed: A.B.& C. Quality of events and documentary evidence		
Total:	**100**	

Criterion 5: Faculty Information and Contributions (200)

Sub Criteria	Marks	Evaluation Guidelines
5.1. Student-Faculty Ratio (SFR)	20	Marks to be given proportionally from a maximum of 20 to a minimum of 10 for average SFR between 15:1 to 25:1, and zero for average SFR higher than 25:1. Marks distribution is given as below: < = 15 - 20 Marks < = 17 - 18 Marks < = 19 - 16 Marks < = 21 - 14 Marks < = 23 - 12 Marks < = 25 - 10 Marks > 25 - 0 Marks
Exhibits/Context to be Observed/Assessed: • *SFR is to be verified considering the faculty of the entire department.* • *No. of Regular faculty calculation considering Regular faculty definition*; Faculty appointment letters, time table, subject allocation file, salary statements.* • *No. of students calculation as mentioned in the SAR(please refer table under criterion 5.1)* • *Faculty Qualification as per AICTE guidelines shall only be counted* **Note: All the faculty whether regular or contractual (except Part-Time), will be considered. The contractual faculty (doing away with the terminology of visiting/adjunct faculty, whatsoever) who have taught for 2 consecutive semesters in the corresponding academic year on full time basis shall be considered for the purpose of calculation in the Faculty Student Ratio. However, following will be ensured in case of contractual faculty:* 1. *Shall have the AICTE prescribed qualifications and experience.* 2. *Shall be appointed on full time basis and worked for consecutive two semesters during the particular academic year under consideration.* 3. *Should have gone through an appropriate process of selection and the records of the same shall be made available to the visiting team during NBA visit*		
5.2. Faculty Cadre Proportion	20	Cadre Proportion Marks = $\left\{\left[\frac{AF1}{RF1}\right] + \left[\frac{AF2}{RF2}\right] \times 0.6 + \left[\frac{AF3}{RF3} \times 0.4\right] \times 10\right\}$ • If AF1 = AF2= 0 then zero marks • Maximum marks to be limited if it exceeds 20 (Refer calculation in SAR)
Exhibits/Context to be Observed/Assessed: *(Faculty Qualification and experience required for cadre posts shall only be considered as per AICTE norms/guidelines)* • *Cadre wise No. of faculty available; Faculty qualification and experience and eligibility; Appointment/Promotion orders* • *Cadre wise no. of faculty required as per AICTE guidelines (refer calculation in SAR)*		

5.3. Faculty Qualification	**20**	FQ = 2.0 x [{10X +4Y}/F] where X is no. of faculty with Ph.D., Y is no. of faculty with M.Tech., F is no. of faculty required to comply 1:20 Faculty Student ratio (no. of faculty and no. of students required to be calculated as per 5.1)
Exhibits/Context to be Observed/Assessed: • *Documentary evidence – Faculty Qualification*		
5.4 Faculty Retention	**10**	A. ≥ 90% of required Faculties retained during the period of assessment keeping CAYm2 as base year (10) B. ≥ 75% of required Faculties retained during the period of assessment keeping CAYm2 as base year (08) C. ≥ 60% of required Faculties retained during the period of assessment keeping CAYm2 as base year (06) D. ≥ 50% of required Faculties retained during the period of assessment keeping CAY*m2* as base year (04) E. Otherwise (0)
Exhibits/Context to be Observed/Assessed: • Faculty date of joining; atleast three-month (July-April-May) salary statement for each of the assessment years		
5.5. Faculty competencies in correlation to Program Specific Criteria	**10**	A. Specialization B. Research Publications C. Course Developments D. Other relevant points
Exhibits/Context to be Observed/Assessed:		
5.6. Innovations by the Faculty in Teaching and Learning	**10**	A. Statement of clear goals, use of appropriate methods, significance of results, effective presentation (4) B. Availability of work on the Institute Website (2) C. Availability of work for peer review and critique (2) D. Reproducibility and Reusability by other scholars for further development (2)
Exhibits/Context to be Observed/Assessed: *A. Availability on Institute website; awareness among faculty and students of the department* *B. & C. Self-explanatory* *D. Innovations that contribute to the improvement of student learning, typically include use of ICT, instruction delivery, instructional methods, assessment, evaluation etc.*		
5.7 Faculty as participants in Faculty development /training activities /STTPs	**15**	For each year: Assessment = 3×Sum/0.5RF Average assessment over last three years starting from CAYm1 (Marks limited to 15)
Exhibits/Context to be Observed/Assessed: *A. Relevance of the training/development program* *B. No. of days; No. of faculty*		

5.8. Research and Development	**75**	
5.8.1. Academic Research	20	A. Number of quality publications in refereed/SCI Journals, citations, Books/Book Chapters etc. (15) B. PhD awarded during the assessment period while working in the institute (5)
Exhibits/Context to be Observed/Assessed: *A. Quality of publications; publications copy; B. Documentary evidence*		
5.8.2 Sponsored Research	20	Funded research from outside; Cumulative during CAYm1, CAYm2 and CAYm3 Amount > 50 Lakh – 20 Marks, Amount >40 and < 50 Lakh – 15 Marks, Amount >30 and < 40 Lakh – 10 Marks, Amount >15 and < 30 Lakh – 5 Marks, Amount< 15 Lakh – 0 Marks
Exhibits/Context to be Observed/Assessed: • *Documentary evidence; Funding agency, Amount, Duration, Research progress; Outcome*		
5.8.3 Development Activities	15	A. Product Development B. Research laboratories C. Instructional materials D. Working models/charts/monograms etc.
Exhibits/Context to be Observed/Assessed: *Self –explanatory*		
5.8.4. Consultancy (From Industry)	20	Consultancy; Cumulative during CAYm1, CAYm2 and CAYm3 Amount >10 Lakh – 20 Marks, Amount <10 and > 8 Lakh – 15 Marks, Amount < 8 and > 6 Lakh – 10 Marks, Amount < 6 and > 4 Lakh – 5 Marks, Amount < 4 and > 2 Lakh – 2 Marks, Amount < 2 Lakh – 0 Mark
Exhibits/Context to be Observed/Assessed: • Documentary evidence; Funding agency, Amount, Duration, Research progress; Outcome		
5.9. Faculty Performance Appraisal and Development System (FPADS)	**10**	A. A well-defined performance appraisal and development system instituted for all the assessment years (5) B. Its implementation and effectiveness (5)
Exhibits/Context to be Observed/Assessed: *A. Notified performance appraisal and development system; Appraisal Parameters; Awareness; B. Implementation, Transparency and Effectiveness*		
5.10. Visiting/Adjunct/Emeritus Faculty etc.	**10**	• Provision of Visiting /Adjunct/Emeritus faculty etc.(1) • Minimum 50 hours per year interaction (per year to obtain three marks : 3 x 3 = 9)
Exhibits/Context to be Observed/Assessed: • *Documentary evidence*		
Total:	**200**	

Criterion 6: Facilities and Technical Support (80)

Sub Criteria	Marks	Evaluation Guidelines
6.1.Adequate and well equipped laboratories, and technical manpower	40	A. Adequate well-equipped laboratories to run all the program-specific curriculum (25) B. Availability of adequate and qualified technical supporting staff (15)
Exhibits/Context to be Observed/Assessed: *A. Adequacy; well-equipped laboratories; utilization* *B. Self - explanatory*		
6.2. Laboratories: Maintenance and overall ambience	10	Maintenance and overall ambience (10)
Exhibits/Context to be Observed/Assessed: Self-explanatory		
6.3. Safety measures in laboratories	10	Safety measures in laboratories (10)
Exhibits/Context to be Observed/Assessed: Self -explanatory		
6.4. Project laboratory/Facilities	20	Facilities & Utilization (20)
Exhibits/Context to be Observed/Assessed: Self -explanatory		
Total:	**80**	

Criterion 7: Continuous Improvement (75)

Sub Criteria	Marks	Evaluation Guidelines
7.1.Actions taken based on the results of evaluation of each of the POs and PSOs	30	A. Documentary evidences of POs and PSOs attainment levels (15) B. Identification of gaps/shortfalls (05) C. Plan of action to bridge the gap and its Implementation (10)
Exhibits/Context to be Observed/Assessed: • *Documentary evidence in respect of each of the Pos*		
7.2 Academic Audit and actions taken during the period of Assessment	15	A. Assessment shall be based on conduct and actions taken in relation to continuous improvement (15)
Exhibits/Context to be Observed/Assessed: *A. Academic Audit assessment criteria, frequency, conduct mechanism, action plan based on audit, implementation and effectiveness*		
7.3. Improvement in Placement, Higher Studies and Entrepreneurship	10	Assessment is based on improvement in: (Refer placement index 4.5) A. Improvement in Placement numbers, quality, core hiring industry and pay packages (5) B. Improvement in Higher Studies admissions for pursuing PhD. in premier institutions(3) C. Improvement in number of Entrepreneurs (2) (Marks to be given proportionately considering nos. in the base year CAYm3)
Exhibits/Context to be Observed/Assessed: *A. B. & C. Nos. in each year of the assessment; improvement considering CAYm3 as a base year*		
7.4. Improvement in the quality of students admitted to the program	20	A. Assessment is based on improvement in terms of ranks/score in qualifying state level/national level entrances tests, percentage Physics, Chemistry and Mathematics marks in 12th Standard and percentage marks of the lateral entry students
Exhibits/Context to be Observed/Assessed: *A. Documentary evidence – list of students admitted; admission authority guidelines; ranks/scores; comparative status considering CAYm3 as a base year*		
Total:	**75**	

Criterion 8: First Year Academics (50)

Sub Criteria	Marks	Evaluation Guidelines
8.1. First Year Student- Faculty Ratio (FYSFR)	05	For each year of assessment = (5 × 20)/ FYSFR (Limited to Max. 5) Average of Assessment of data in CAY, CAYm1 and CAYm2 *Note: If FYSFR is greater than 25, then assessment equal to zero.
Exhibits/Context to be Observed/Assessed: • *No. of Regular faculty calculation considering Regular faculty definition and fractional load; Faculty appointment letters; Salary statements* • *No. of students calculation as mentioned in the SAR*		
8.2. Qualification of Faculty Teaching First Year Common Courses	05	A. Assessment of faculty qualification (5x + 3y)/RF B. Average of Assessment of previous three academic years including current academic year. (Refer 8.2. for x, y and RF)
Exhibits/Context to be Observed/Assessed: • Documentary evidence – Faculty Qualification		
8.3. First Year Academic Performance	10	Academic Performance = ((Mean of 1st Year Grade Point Average of all successful Students on a 10 point scale) or (Mean of the percentage of marks in First Year of all successful students/10)) x (successful students/number of students appeared in the examination) (Successful students are those who are permitted to proceed to the Second year)
Exhibits/Context to be Observed/Assessed: *Data to be verified for atleast one of the assessment years*		
8.4. Attainment of Course Outcomes of first year courses	**10**	
8.4.1. Describe the assessment processes used to gather the data upon which the evaluation of Course Outcomes of first year is based	05	A. List of assessment processes (1) B. The relevance of assessment tools used (4)
Exhibits/Context to be Observed/Assessed *A. & B. Direct and indirect assessment(if applicable), tools & processes; effective compliance; direct assessment methodology, indirect assessment formats-collection-analysis; decision making*		
8.4.2. Record the attainment of Course Outcomes of all first year courses	05	A. Verify the records as per the benchmark set for the courses (5)
Exhibits/Context to be Observed/Assessed: *A. Documentary evidence – Attainment for atleast 3 courses*		

8.5. Attainment of Program Outcomes of all first year courses	**20**	
8.5.1. Indicate results of evaluation of each relevant PO/PSO	10	A. Process of computing POs/PSOs attainment level from the COs of related first year courses (5) B. Verification of documents validating the above process (5)
Exhibits/Context to be Observed/Assessed: *A. & B. Documentary evidence for each relevant PO/PSO*		
8.5.2. Actions taken based on the results of evaluation of relevant POs /PSOs	10	A. Appropriate actions taken (10)
Exhibits/Context to be Observed/Assessed: *A. Documentary evidence for each relevant PO/PSO*		
Total:	**50**	

Criterion 9: Student Support Systems (50)

Sub Criteria	Marks	Evaluation Guidelines
9.1. Mentoring system to help at individual level	05	A. Details of the mentoring system that has been developed for the students for various purposes and also state the efficacy of such system (5)
Exhibits/Context to be Observed/Assessed: *A. Mentoring system terms of reference; implementation; effectiveness (also to be verified during interaction with the students)*		
9.2. Feedback analysis and reward /corrective measures taken, if any	10	A. Methodology being followed for analysis of feedback and its effectiveness (5) B. Record of corrective measures taken (5)
Exhibits/Context to be Observed/Assessed: *A. Feedback questions, collection process, analysis, actions taken, effectiveness*		
9.3. Feedback on facilities	05	A. Feedback collection, analysis and corrective action (5)
Exhibits/Context to be Observed/Assessed: Self – explanatory		
9.4. Self - Learning	05	A. Scope for self-learning (2) B. The institution needs to specify the facilities, materials for learning beyond syllabus, Webinars, Podcast, MOOCs etc. and demonstrate its effective utilization (3)
Exhibits/Context to be Observed/Assessed: *Self – explanatory*		
9.5. Career Guidance, Training, Placement	10	A. Availability of career guidance facilities (2) B. Counseling for higher studies (GATE/GRE, GMAT, etc.) (2) C. Pre-placement training (3) D. Placement process and support (3)
Exhibits/Context to be Observed/Assessed: *Availability, implementation, effectiveness (also to be verified during interaction with the students)*		
9.6. Entrepreneurship Cell	05	A. Entrepreneurship initiatives (3) B. Data on students benefitted (2)
Exhibits/Context to be Observed/Assessed: *Availability, implementation, effectiveness (also to be verified during interaction with the students)*		
9.7. Co-curricular and Extra- curricular Activities	10	A. Availability of sports and cultural facilities (3) B. NCC, NSS and other clubs (3) C. Annual students activities (4)
Exhibits/Context to be Observed/Assessed: *Availability, implementation, effectiveness (also to be verified during interaction with the students)*		
Total:	**50**	

Criterion 10: Governance, Institutional Support and Financial Resources (120)

Sub Criteria	Marks	Evaluation Guidelines
10.1. Organization, Governance and Transparency	**55**	
10.1.1.State the Vision and Mission of the Institute	05	A. Availability of the Vision & Mission statements of the Institute (2) B. Appropriateness/ Relevance of the Statements (3)
Exhibits/Context to be Observed/Assessed: *A. Institute Vision and Mission statements: Availability of statements on Institute website; Availability at Central facilities such as Library, Computer Center, Principal Chamber etc. Availability of one set of statements in each of the departments; Availability in Institute level documents* *B. Correctness from definition perspective*		
10.1.2. Availability of the Institutional Strategic Plan and its Effective Implementation and Monitoring	25	Availability of a 5 year Strategic Plan.
Exhibits/Context to be Observed/Assessed:		
10.1.3. Governing body, administrative setup, functions of various bodies, service rules procedures, recruitment and promotional policies.	10	A. List the Governing Body Composition and its Sub Committees, senate, and all other academic and administrative bodies; their memberships, functions, and responsibilities; frequency of the meetings; participation details of external members and attendance therein (4) B. The published service rules, policies and procedures with year of publication (3) C. Minutes of the meetings and action-taken reports (3)
Exhibits/Context to be Observed/Assessed: *Self - explanatory*		
10.1.4. Decentralization in working and grievance redressal mechanism	05	A. Organizational Structure, List of Administrative Committees and Administrative Heads who have been delegated powers for taking administrative decisions (1) B. Specify the mechanism and composition of grievance redressal cell (1) C. Action taken report of representations (sample) (3)
Exhibits/Context to be Observed/Assessed: *A. B. & C. Documentary evidence*		
10.1.5. Delegation of financial powers	05	A. Financial powers delegated to the Principal, Heads of Departments and relevant in-charges (2) B. Demonstrate the utilization of financial powers for each of the assessment years (3)
Exhibits/Context to be Observed/Assessed: *A. Circulars notifying financial powers* *B. Documentary evidence to exhibit utilization at each levels during assessment years*		
10.1.6. Transparency and availability of correct/ unambiguous information in public domain	05	A. Information on the policies, rules, processes is to be made available on web site (2) B. Dissemination of the information about student, faculty and staff (2) C. Mandatory disclosure as per AICTE/AISHE on the website. (1)
Exhibits/Context to be Observed/Assessed: *A. & B. Website and Documentary evidence*		

10.2. Budget Allocation, Utilization, and Public Accounting at Institute level	**15**	
10.2.1. Adequacy of Budget allocation	05	A. Quantum of budget allocation for three years (3) B. Justification of budget allocated for three years (2)
Exhibits/Context to be Observed/Assessed: A. Budget formulation, finalization and approval process; Requirement – allocation –adequacy – justification thereof		
10.2.2. Utilization of allocated funds	05	A. Budget utilization for three years (5)
Exhibits/Context to be Observed/Assessed: *A. Balance sheet; effective utilization; random verification for atleast two of the three assessment years*		
10.2.3. Availability of the audited Statements on the institute's website	05	A. Availability of Audited statements on website (5)
Exhibits/Context to be Observed/Assessed: ***A.*** *Website*		
10.3. Program Specific Budget Allocation, Utilization	**30**	To be evaluated in consultation with the Program Experts
10.3.1. Adequacy of budget allocation	10	A. Quantum of budget allocation for three years (5) B. Justification of budget allocated for three years (5)
Exhibits/Context to be Observed/Assessed: *A. Budget formulation, finalization and approval process; Requirement – allocation –adequacy – justification thereof*		
10.3.2. Utilization of allocated funds	20	A. Budget utilization for three years (20)
Exhibits/Context to be Observed/Assessed: *A. Balance sheet; effective utilization; random verification for atleast two of the three assessment years*		
10.4. Library and Internet	**20**	
10.4.1. Quality of learning resources (hard/soft)	10	• Availability of relevant learning resources including e-resources and Digital Library (7) • Accessibility to students (3)
Exhibits/Context to be Observed/Assessed: *Availability; Adequacy; Effectiveness (Also to be verified during interactions with the faculty and students)*		
10.4.2. Internet	10	A. Available bandwidth (4) B. Wi Fi availability (2) C. Internet access in labs, classrooms, library and offices of all Departments (2) D. Security mechanism (2)
Exhibits/Context to be Observed/Assessed: *Availability as per AICTE norms; Adequacy; Effectiveness (Also to be verified during interactions with the faculty and students)*		
Total:	**120**	

Q &A

THANK YOU

ALL THE BEST

WELCOME YOUR FEEDBACK