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Policy for Examination Reforms (W.e.f 2021-22)

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Examination Reforms Policy

The globalization of the world economy and higher education is causing significant changes in engineering education. To guarantee that we remain competitive and can effectively respond to the difficulties of globalization, we must continue to dynamically adapt to these changes. Future engineering graduates will need a new set of soft, professional skills and abilities in addition to their technical expertise.

Engineering education has seen significant changes in recent years in terms of what to teach (topic), how to teach (knowledge delivery), and how to assess (student learning).

The AICTE has already begun the process of developing a model curriculum for engineering programmes. Through SWAYAM, the MHRD and AICTE's digital initiatives have made a huge number of MOOC courses online, which can assist colleges and teachers in adopting novel course delivery strategies.

Dr. Sudhir Chandra Sur Institute of Technology and Sports Complex (DSCSITSC) has also taken the initiative to create our own Examination Reforms Policy based on the AICTE and MAKAUT guidelines.

In the light of the evolving landscape of engineering education, the current report focuses on proposals for modifications in examinations (student assessment).

Examinations/student assessments serve a critical role in determining educational quality. They must examine not simply the achievements (and grades) of students, but also whether the desired learning outcomes have been met. The accomplishment of goals and programme outcomes is critical, and it must be demonstrated through precise and trustworthy assessments.

For a long time, the academic quality of examinations (question papers) in the Indian engineering school system has been a source of worry. It is commonly accepted that "evaluation drives learning," and what and how students' study is heavily influenced by how they believe they will be evaluated. Simple memory recall will not assure deep, meaningful learning in question papers. High learning expectations encourage students to rise to the challenge. To guarantee that the learner is motivated to meet those high expectations, the assessment (examination) must implant them.

Exam reforms are necessary for improving the quality of Indian engineering education, given the imperatives. The following are the most major drivers for examination reform in Indian engineering education:

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Adaptation of Outcome-Based Education Framework

In the worldwide engineering education situation, outcome-based education (OBE), a performance-based approach, has emerged as a prominent reform model. A country must implement OBE to become a signatory member of a global agreement for the mutual recognition of engineering degrees, such as the Washington Accord (WA). This will be an affirmation that the engineering education system has exhibited a strong, long-term commitment to quality assurance in generating engineers suited for international industry practice. The National Board of Accreditation (NBA), an Indian accreditation agency that is a signatory to the Washington Accord, has made it essential for engineering colleges to use the OBE framework for curriculum design, delivery, and assessment. The educational outcomes of a programme are clearly and unambiguously articulated in the OBE framework. The content and organization of the curriculum, as well as the teaching methods and strategies and the evaluation process, are all determined by these factors.

Though we are the Non-Autonomous Institute, we have begun to adopt the OBE framework for our engineering programmes, the focus has thus far been on the curriculum modification aspect, which involves tying curricular components to programme outcomes.

Importance of Higher-order Abilities and Professional Skills

Memorization is the most important aspect of the current examination system. Although recall of factual knowledge is necessary for any examination, it is simply one of several major competencies that graduates must exhibit.

Higher-level skills, such as the capacity to apply knowledge, solve complicated issues, analyze, synthesize, and design, must also be tested during the assessment process.

Professional qualities such as communication, teamwork, and continual learning have also become crucial aspects for graduates' employability. It's critical that the examinations provide these higher-level talents and professional competences enough weight in the assessment.

Considering the above problems and a review of some of the world's best assessment techniques, the current policy offers various recommendations that our college has used to develop our assessment strategy.

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ASSESSMENT STRATEGY FOR OUTCOME-BASED EDUCATION

Mapping Program Outcomes to Assessment (Examinations)

Graduate attributes (GAs) define the general skills that a graduate of any undergraduate degree programme should possess. They combine to generate Program Outcomes (POs), which reflect graduates' skills, knowledge, and competencies regardless of subject of study. This is not to say that POs are unaffected by disciplinary knowledge; rather, these abilities can be acquired in a variety of academic settings.

A "design down" method is used in outcome-based education to move from POs to Course Outcomes (COs) to outcomes for individual learning experiences. Each successive level's outcomes must relate to and contribute to the program's goals.

A program's foundation is made up of courses. Teaching tactics, learning activities, assessments, and resources should all be developed and arranged to assist students in achieving course-level learning outcomes. Students demonstrate their degree of achievement of the course learning outcomes in the assessment tasks. The courses in a constructively aligned programme are meticulously organized to promote steady development or scaffolding from the introduction through mastery of the learning outcomes, ultimately leading to the attainment of the targeted POs. The achievement of POs is critical for the program's efficacy, which must be demonstrated by precise and trustworthy assessments.

Two-step Process for Bringing Clarity to POs

POs are beneficial for curriculum design, delivery, and assessment of student learning at the programme level. They are, however, generic high-level goals that are not directly measurable. At the course level, real observability and measurability of the POs is extremely challenging. There is a need to provide more clarity and specificity to the programme results to tie high-level learning outcomes (POs) with course content, course outcomes, and evaluation. This can be accomplished using the two-step approach of establishing Competencies and Performance Indicators outlined below (PI).

1) **Identify Competencies to be attained:** Define skills for each PO - varied abilities implied by the programme result statement that would necessitate distinct evaluation measures in most cases. This aids in the development of a common understanding of the competencies we want students to attain. They are used as a phase in the process of developing measurable indicators.
2) **Define Performance Indicators:** Define performance Indicators (PIs) for each of the selected capabilities that are explicit assertions of student learning objectives. They can be used as measuring instruments in assessments to determine the extent to which outcomes have been achieved. They can also be constructed to determine the proper achievement level or competency of each indication, allowing teachers to set goals and students to reach a

satisfactory level of proficiency.

It should be highlighted that, when considering the programme outcome, it appears that only the Capstone project will be able to achieve it. However, when we study the competences and performance indicators, we can see how these (and hence PO) can be addressed in various courses throughout the programme.

Once the program's assessment process is complete, the assessment of COs for all courses is created by connecting assessment questions (used in various assessment systems) to the PIs. We achieve clarity and better resolution for the assessment of COs and POs by following this method, where examination questions map to PIs. Figure 1 shows a visual representation of the procedure.

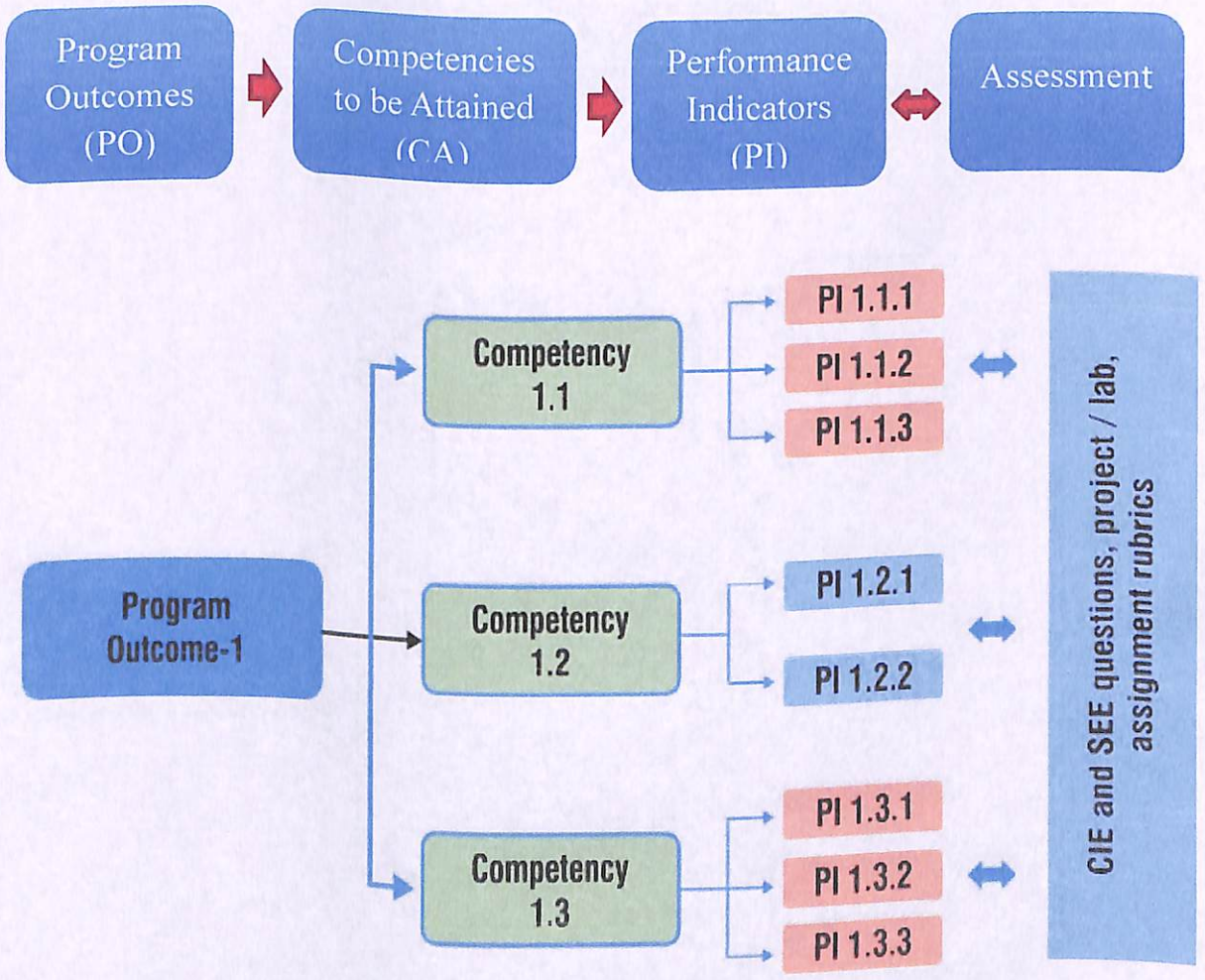

Figure. 1: Connecting POs to Assessment

Program Outcomes – Competencies – Performance Indicators

For each of the PO in Mechanical Engineering Program, the following table provides a suggested list of competences and associated performance metrics.

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 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 public health and safety, and cultural, societal, and environmental considerations.

Competency		Indicators	
3.1	Demonstrate an ability to define a complex/ open-ended problem in engineering terms	3.1.1	Recognize that need analysis is key to good problem definition
		3.1.2	Elicit and document, engineering requirements from stakeholders
		3.1.3	Synthesize engineering requirements from a review of the state-of-the-art
		3.1.4	Extract engineering requirements from relevant engineering Codes and Standards such as ASME, ASTM, BIS, ISO and ASHRAE.
		3.1.5	Explore and synthesize engineering requirements considering health, safety risks, environmental, cultural and societal issues
		3.1.6	Determine design objectives, functional requirements and arrive at specifications
3.2	Demonstrate an ability to generate a diverse set of alternative design solutions	3.2.1	Apply formal idea generation tools to develop multiple engineering design solutions
		3.2.2	Build models/prototypes to develop a diverse set of design solutions
		3.2.3	Identify suitable criteria for the evaluation of alternate design solutions
3.3	Demonstrate an ability to select an optimal design scheme for further development	3.3.1	Apply formal decision-making tools to select optimal engineering design solutions for further development
		3.3.2	Consult with domain experts and stakeholders to select candidate engineering design solution for further development
3.4	Demonstrate an ability to advance an engineering design to defined end state	3.4.1	Refine a conceptual design into a detailed design within the existing constraints (of the resources)
		3.4.2	Generate information through appropriate tests to improve or revise the design

PO 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.

Competency		Indicators	
4.1	Demonstrate an ability to conduct investigations of technical issues consistent with their level of knowledge and understanding	4.1.1	Define a problem, its scope and importance for purposes of investigation
		4.1.2	Examine the relevant methods, tools and techniques of experiment design, system calibration, data acquisition, analysis and presentation
		4.1.3	Apply appropriate instrumentation and/or software tools to make measurements of physical quantities
		4.1.4	Establish a relationship between measured data and underlying physical principles.
4.2	Demonstrate an ability to design experiments to solve open-ended problems	4.2.1	Design and develop an experimental approach, specify appropriate equipment and procedures
		4.2.2	Understand the importance of the statistical design of experiments and choose an appropriate experimental design plan based on the study objectives
4.3	Demonstrate an ability to analyze data and reach a valid conclusion	4.3.1	Use appropriate procedures, tools and techniques to conduct experiments and collect data
		4.3.2	Analyze data for trends and correlations, stating possible errors and limitations
		4.3.3	Represent data (in tabular and/or graphical forms) so as to facilitate analysis and explanation of the data, and drawing of conclusions
		4.3.4	Synthesize information and knowledge about the problem from the raw data to reach appropriate conclusions

PO 5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Competency		Indicators	
5.1	Demonstrate an ability to identify/ create modern engineering tools, techniques and resources	5.1.1	Identify modern engineering tools such as computer-aided drafting, modeling and analysis; techniques and resources for engineering activities
		5.1.2	Create/adapt/modify/extend tools and techniques to solve engineering problems
5.2	Demonstrate an ability to select and apply discipline-specific tools, techniques and resources	5.2.1	Identify the strengths and limitations of tools for (i) acquiring information, (ii) modeling and simulating, (iii) monitoring system performance, and (iv) creating engineering designs.
		5.2.2	Demonstrate proficiency in using discipline-specific tools
5.3	Demonstrate an ability to evaluate the suitability and limitations of tools used to solve an engineering problem	5.3.1	Discuss limitations and validate tools, techniques and resources
		5.3.2	Verify the credibility of results from tool use with reference to the accuracy and limitations, and the assumptions inherent in their use.

PO 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.

Competency		Indicators	
6.1	Demonstrate an ability to describe engineering roles in a broader context, e.g. pertaining to the environment, health, safety, legal and public welfare	6.1.1	Identify and describe various engineering roles; particularly as pertains to protection of the public and public interest at the global, regional and local level
6.2	Demonstrate an understanding of professional engineering regulations, legislation and standards	6.2.1	Interpret legislation, regulations, codes, and standards relevant to your discipline and explain its contribution to the protection of the public

PO 7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and the need for sustainable development.

Competency		Indicators	
7.1	Demonstrate an understanding of the impact of engineering and industrial practices on social, environmental and in economic contexts	7.1.1	Identify risks/impacts in the life-cycle of an engineering product or activity
		7.1.2	Understand the relationship between the technical, socio-economic and environmental dimensions of sustainability
7.2	Demonstrate an ability to apply principles of sustainable design and development	7.2.1	Describe management techniques for sustainable development
		7.2.2	Apply principles of preventive engineering and sustainable development to an engineering activity or product relevant to the discipline

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	Identify tenets of the ASME professional code of ethics
		8.2.2	Examine and apply moral & ethical principles to known case studies

PO 9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

	Competency		Indicators
9.1	Demonstrate an ability to form a team and define a role for each member	9.1.1	Recognize a variety of working and learning preferences; appreciate the value of diversity on a team
		9.1.2	Implement the norms of practice (e.g. rules, roles, charters, agendas, etc.) of effective team work, to accomplish a goal.
9.2	Demonstrate effective individual and team operations--communication, problem-solving, conflict resolution and leadership skills	9.2.1	Demonstrate effective communication, problem-solving, conflict resolution and leadership skills
		9.2.2	Treat other team members respectfully
		9.2.3	Listen to other members
		9.2.4	Maintain composure in difficult situations
9.3	Demonstrate success in a team-based project	9.3.1	Present results as a team, with smooth integration of contributions from all individual efforts

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 11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

Competency		Indicators
11.1	Demonstrate an ability to evaluate the economic and financial performance of an engineering activity	11.1.1 Describe various economic and financial costs/benefits of an engineering activity 11.1.2 Analyze different forms of financial statements to evaluate the financial status of an engineering project
11.2	Demonstrate an ability to compare and contrast the costs/benefits of alternate proposals for an engineering activity	11.2.1 Analyze and select the most appropriate proposal based on economic and financial considerations.
11.3	Demonstrate an ability to plan/manage an engineering activity within time and budget constraints	11.3.1 Identify the tasks required to complete an engineering activity, and the resources required to complete the tasks. 11.3.2 Use project management tools to schedule an engineering project, so it is completed on time and on budget.

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.

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A suggestive list of competencies and associated performance indicators for Computer Science & Engineering/ Information Technology Programs is given bellow:

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
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

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	2.5.1	Evaluate problem statements and identifies objectives
		2.5.2	Identify processes/modules/algorithms of a computer-based system and parameters to solve a problem
		2.5.3	Identify mathematical algorithmic knowledge that applies to a given problem
2.6	Demonstrate an ability to formulate a solution plan and methodology for an engineering problem	2.6.1	Reframe the computer-based system into interconnected subsystems
		2.6.2	Identify functionalities and computing resources.
		2.6.3	Identify existing solution/methods to solve the problem, including forming justified approximations and assumptions
		2.6.4	Compare and contrast alternative solution/methods to select the best methods
		2.6.5	Compare and contrast alternative solution processes to select the best process.
2.7	Demonstrate an ability to formulate and interpret a model	2.7.1	Able to apply computer engineering principles to formulate modules of a system with required applicability and performance.
		2.7.2	Identify design constraints for required performance criteria.
2.8	Demonstrate an ability to execute a solution process and analyze results	2.8.1	Applies engineering mathematics to implement the solution.
		2.8.2	Analyze and interpret the results using contemporary tools.
		2.8.3	Identify the limitations of the solution and sources/causes.
		2.8.4	Arrive at conclusions with respect to the objectives.

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PO 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 public health and safety, and cultural, societal, and environmental considerations.

Competency		Indicators	
3.5	Demonstrate an ability to define a complex/ open-ended problem in engineering terms	3.5.1	Able to define a precise problem statement with objectives and scope.
		3.5.2	Able to identify and document system requirements from stake- holders.
		3.5.3	Able to review state-of-the-art literature to synthesize system requirements.
		3.5.4	Able to choose appropriate quality attributes as defined by ISO/IEC/IEEE standard.
		3.5.5	Explore and synthesize system requirements from larger social and professional concerns.
		3.5.6	Able to develop software requirement specifications (SRS).
3.6	Demonstrate an ability to generate a diverse set of alternative design solutions	3.6.1	Able to explore design alternatives.
		3.6.2	Able to produce a variety of potential design solutions suited to meet functional requirements.
		3.6.3	Identify suitable non-functional requirements for evaluation of alternate design solutions.
3.7	Demonstrate an ability to select optimal design scheme for further development	3.7.1	Able to perform systematic evaluation of the degree to which several design concepts meet the criteria.
		3.7.2	Consult with domain experts and stakeholders to select candidate engineering design solution for further development
3.8	Demonstrate an ability to advance an engineering design to defined end state	3.8.1	Able to refine architecture design into a detailed design within the existing constraints.
		3.8.2	Able to implement and integrate the modules.
		3.8.3	Able to verify the functionalities and validate the design.

PO 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.

Competency		Indicators	
4.4	Demonstrate an ability to conduct investigations of technical issues consistent with their level of knowledge and understanding	4.4.1	Define a problem for purposes of investigation, its scope and importance
		4.4.2	Able to choose appropriate procedure/algorithm, dataset and test cases.
		4.4.3	Able to choose appropriate hardware/software tools to conduct the experiment.
4.5	Demonstrate an ability to design experiments to solve open-ended problems	4.5.1	Design and develop appropriate procedures/methodologies based on the study objectives
4.6	Demonstrate an ability to analyze data and reach a valid conclusion	4.6.1	Use appropriate procedures, tools and techniques to collect and analyze data
		4.6.2	Critically analyze data for trends and correlations, stating possible errors and limitations
		4.6.3	Represent data (in tabular and/or graphical forms) so as to facilitate analysis and explanation of the data, and drawing of conclusions
		4.6.4	Synthesize information and knowledge about the problem from the raw data to reach appropriate conclusions

PO 5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Competency		Indicators	
5.4	Demonstrate an ability to identify/create modern engineering tools, techniques and resources	5.4.1	Identify modern engineering tools, techniques and resources for engineering activities
		5.4.2	Create/adapt/modify/extend tools and techniques to solve engineering problems
5.5	Demonstrate an ability to select and apply discipline-specific tools, techniques and resources	5.5.1	Identify the strengths and limitations of tools for (i) acquiring information, (ii) modeling and simulating, (iii) monitoring system performance, and (iv) creating engineering designs.
		5.5.2	Demonstrate proficiency in using discipline-specific tools
5.6	Demonstrate an ability to evaluate the suitability and limitations of tools used to solve an engineering problem	5.6.1	Discuss limitations and validate tools, techniques and resources
		5.6.2	Verify the credibility of results from tool use with reference to the accuracy and limitations, and the assumptions inherent in their use.

PO 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.

Competency		Indicators	
6.3	Demonstrate an ability to describe engineering roles in a broader context, e.g. pertaining to the environment, health, safety, legal and public welfare	6.3.1	Identify and describe various engineering roles; particularly as pertains to protection of the public and public interest at the global, regional and local level
6.4	Demonstrate an understanding of professional engineering regulations, legislation and standards	6.4.1	Interpret legislation, regulations, codes, and standards relevant to your discipline and explain its contribution to the protection of the public

PO 7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and the need for sustainable development.

Competency		Indicators	
7.3	Demonstrate an understanding of the impact of engineering and industrial practices on social, environmental and in economic contexts	7.3.1	Identify risks/impacts in the life-cycle of an engineering product or activity
		7.3.2	Understand the relationship between the technical, socio-economic and environmental dimensions of sustainability
7.4	Demonstrate an ability to apply principles of sustainable design and development	7.4.1	Describe management techniques for sustainable development
		7.4.2	Apply principles of preventive engineering and sustainable development to an engineering activity or product relevant to the discipline

PO 8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

	Competency	Indicators
8.3	Demonstrate an ability to recognize ethical dilemmas	8.3.1 Identify situations of unethical professional conduct and propose ethical alternatives
8.4	Demonstrate an ability to apply the Code of Ethics	8.4.1 Identify tenets of the ASME professional code of ethics Examine and apply moral & ethical principles to known case studies

PO 9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

	Competency	Indicators
9.4	Demonstrate an ability to form a team and define a role for each member	9.4.1 Recognize a variety of working and learning preferences; appreciate the value of diversity on a team 9.4.2 Implement the norms of practice (e.g. rules, roles, charters, agendas, etc.) of effective team work, to accomplish a goal.
9.5	Demonstrate effective individual and team operations--communication, problem-solving, conflict resolution and leadership skills	9.5.1 Demonstrate effective communication, problem-solving, conflict resolution and leadership skills 9.5.2 Treat other team members respectfully 9.5.3 Listen to other members 9.5.4 Maintain composure in difficult situations
9.6	Demonstrate success in a team-based project	9.6.1 Present results as a team, with smooth integration of contributions from all individual efforts

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
10.4	Demonstrate an ability to comprehend technical literature and document project work	10.4.1 Read, understand and interpret technical and non-technical information 10.4.2 Produce clear, well-constructed, and well-supported written engineering documents 10.4.3 Create flow in a document or presentation - a logical progression of ideas so that the main point is clear
10.5	Demonstrate competence in listening, speaking, and presentation	10.5.1 Listen to and comprehend information, instructions, and viewpoints of others 10.5.2 Deliver effective oral presentations to technical and non-technical audiences
10.6	Demonstrate the ability to integrate different modes of communication	10.6.1 Create engineering-standard figures, reports and drawings to complement writing and presentations 10.6.2 Use a variety of media effectively to convey a message in a document or a presentation

PO 11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

Competency	Indicators
11.4 Demonstrate an ability to evaluate the economic and financial performance of an engineering activity	11.4.1 Describe various economic and financial costs/benefits of an engineering activity 11.4.2 Analyze different forms of financial statements to evaluate the financial status of an engineering project
11.5 Demonstrate an ability to compare and contrast the costs/benefits of alternate proposals for an engineering activity	11.5.1 Analyze and select the most appropriate proposal based on economic and financial considerations.
11.6 Demonstrate an ability to plan/manage an engineering activity within time and budget constraints	11.6.1 Identify the tasks required to complete an engineering activity, and the resources required to complete the tasks. Use project management tools to schedule an engineering project, so it is completed on time and onbudget.

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
12.4 Demonstrate an ability to identify gaps in knowledge and a strategy to close these gaps	12.4.1 Describe the rationale for the requirement for continuing professional development 12.4.2 Identify deficiencies or gaps in knowledge and demonstrate an ability to source information to close this gap
12.5 Demonstrate an ability to identify changing trends in engineering knowledge and practice	12.5.1 Identify historic points of technological advance in engineering that required practitioners to seek education in order to stay current 12.5.2 Recognize the need and be able to clearly explain why it is vitally important to keep current regarding new developments in your field
12.6 Demonstrate an ability to identify and access sources for new information	12.6.1 Source and comprehend technical literature and other credible sources of information 12.6.2 Analyze sourced technical and popular information for feasibility, viability, sustainability, etc.

IMPROVING STRUCTURE AND QUALITY OF ASSESSMENTS / EVALUATION

Goals of Evaluation

- To clarify objectives of education
- To provide guidance & remedial work
- To identify the problems of students & their needs, levels and development
- To improve the skills of learning in students
- To bring improvements in instructional strategies & teaching-learning process
- To assess the educational value and utility of the educational programme
- To provide useful feedback
- To influence decision making or policy formulation by provision of empirically driven
- To assess personality of the pupils
- To analyze teacher student behavior
- To analyze effectiveness of A.V. aids

Defects in traditional evaluation system

- Assessment in not followed systematically as well as continually
- Competencies are not assessed through traditional system of evaluation.
- Assessment is too often carried out. One can't get a realistic picture of what students have mastered.
- After evaluation students are unable to apply what they have learnt through different concepts.
- Feedback provided is not at all formatives.
- Learning difficulties cannot be identified.
- The personal and social qualities are totally ignored Remedial instruction is not provided
- Instructional strategies cannot be assessed.

Needs of Reformation of traditional evaluation system

Education remains the primary engine of upward economic mobility. Due to the pioneering entrepreneurial efforts of a few in Bangalore and Hyderabad, India is today uniquely poised to become an intellectual powerhouse in the new 'knowledge' era.

Pharmaceutical and biotech research, consulting, and of course software development, all promise hundreds of thousands of high-paying and fulfilling jobs—if, however, the Indian education system can produce students with the required skill-sets and attitudes.

It would have to tap students in small towns and rural areas—not merely because a larger number of 'knowledge workers' will be needed than big cities could produce but because social justice demands that the rural and small-town population be given (howsoever belatedly) the opportunity to benefit from the newer engines of economic growth.

So, the Teaching-Learning Procedures & the Evaluation through the Test & Examination should be reformed.

The following points should be remembered to improve the structure and quality of evaluation in various engineering programmes:

- Written examinations play a significant role in assessing student learning and granting grades in the Indian engineering education system. In terms of total grading, the college places the greatest emphasis on the results of written examinations. The level of learning the student is expected to attain in the courses, and hence in the programme, is determined by the questions raised in the examination/test papers. Because evaluation motivates students to study, the design of question papers must go beyond a simple memory test. They must also put higher-order abilities and skills to the test.

- Written tests only examine a small number of outcomes and cognitive levels. Written tests alone will not be adequate to provide reliable judgments about student learning, particularly in courses where course outcomes (COs) cover a broad range of expectations. To ensure that assessment techniques fit learning outcomes, a variety of assessment methods (e.g., term papers, open-ended problem-solving assignments, course/lab project rubrics, portfolios, etc.) must be used.

- To create the evaluation plans for each of the program's courses to clarify the following:
    a. Alignment of assessment with course learning outcomes
    b. Learning level (cognitive) expected of students
    c. Assessment method to be adapted
- The mechanism for aligning examination questions/assessments to COs and thus POs using Bloom's taxonomy to design the best examination paper structure for testing various cognitive skills are addressed.

Bloom's Taxonomy for Assessment Design

Bloom's Taxonomy is a useful framework for developing not only curriculum and teaching methods, but also relevant examination questions for various cognitive levels.

Bloom's Taxonomy of Educational Objectives, created by Benjamin Bloom in 1956, is widely used by educators for curriculum development and assessment. Bloom's taxonomy was changed by Anderson and Krathwohl in 2001 to make it more relevant to today's needs. It tries to categories learning into three sorts of domains (cognitive, affective, and behavioral) and then assigns a level of performance to each. Conscious efforts to map the curriculum and assessment to these levels can aid programmes in aiming for higher-level abilities that need application, analysis, evaluation, or creation, rather than just remembering or understanding.

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 (Fig. 2) which are appropriate for the purposes of engineering educators.

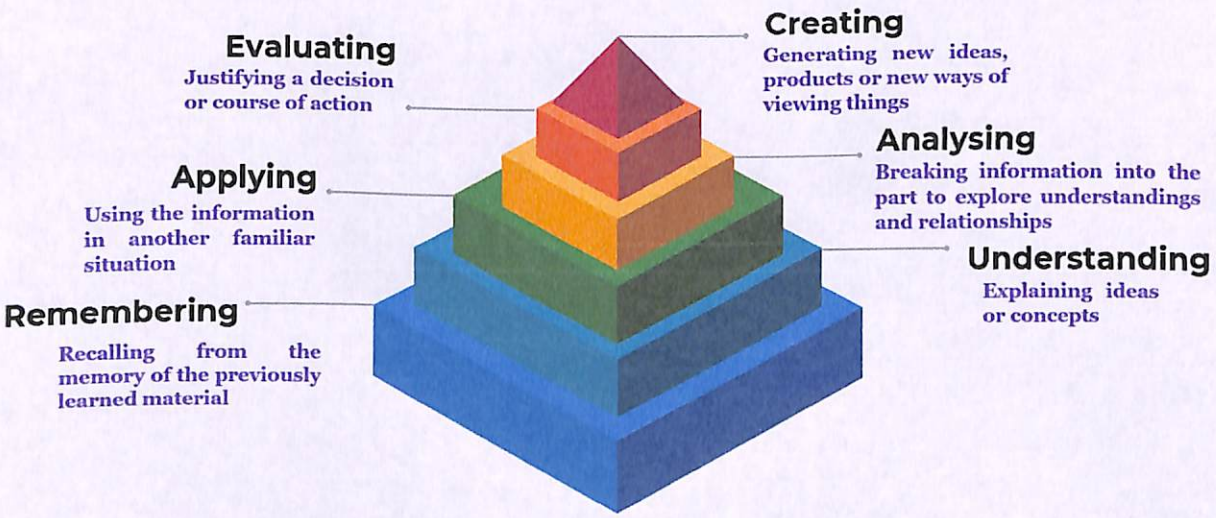


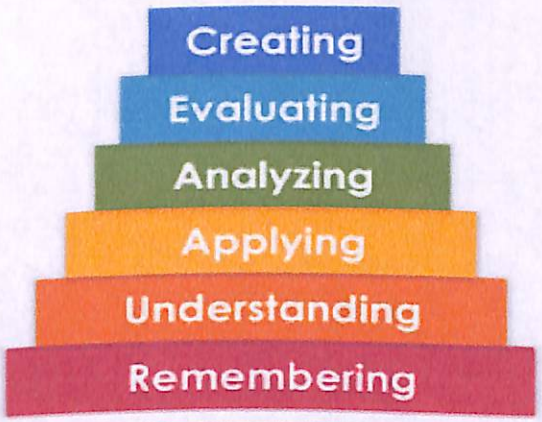
Fig. 2: Revised Bloom's Taxonomy

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
3	Applying	Using the information in another familiar situation
4	Analysing	Breaking information into the part to explore understandings and relationships
5	Evaluating	Justifying a decision or course of action
6	Creating	Generating new ideas, products or new ways of viewing things

Bloom's taxonomy is hierarchical, which means that learning at a higher level necessitates mastering skills at a lower one.

Suggestive list of skills/ competencies & Action Verbs for Assessment:



It's crucial to think about action verbs while creating evaluation questions. The action verbs are frequently indicative of the question's complexity (level). Educators have developed a taxonomy of quantifiable verbs that match to each of Bloom's cognitive levels across time. These verbs assist us in not just describing and categorizing observable knowledge, skills, and talents, but also in framing examination or assignment questions that are appropriate for the level we are attempting to assess.

Level	Skill Demonstrated	Question cues / Verbs for tests
1. Remember	• 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, tell, describe, recite, recall, identify, show, label, tabulate, quote, name, who, when, where
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
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

Types of Evaluation

Examination

The term **examination** is strongly associated with **formal certification** for some purpose, be it in regular education or more general societal contexts.

Most of the times it results in some sort of **licence** to offer certain services and call oneself so or so (e.g. being a lawyer, being a physician, etc.), to use some device or practice some procedure (e.g. driver licence), or generally to ascertain publicly that one has got a certain skill or competence (e.g., a PhD).

Test

Tests are much more science-based, empirical, or technical, and have a much narrower scope than examinations.

Moreover, the terms 'test' and 'testing' are not only used for demonstrating specific **qualities of people** (as in intelligence test), but also of **material things or physical processes** (mainly in natural sciences and engineering).

The precise characteristics of tests and methodologies of testing are usually strictly rooted in relevant **empirical theories** and bound to explicit statistical or other mathematical **methods and techniques**.

Think e.g., of psychometric tests of competence or skills, audiometric tests (or hearing), material tests (e.g., stiffness, elasticity), etc.

Planning and designing of assessment of student learning using Bloom's Taxonomy

While using Bloom's taxonomy framework in planning and designing of assessment of student learning, following points need to be considered:

1. 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.

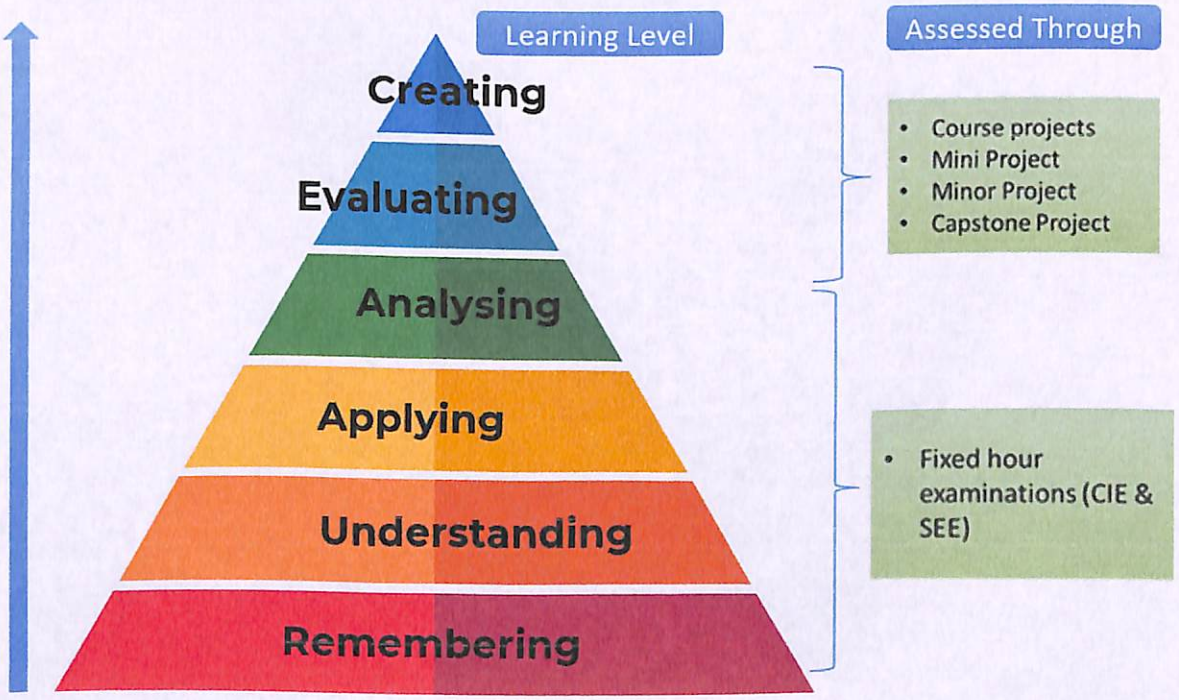


Fig. 3: Assessment methods for different Bloom's cognitive levels

2. Before adopting this framework for reforms in examination system of a University/Institution, it is worthwhile to study the present pattern of assessment in each of the course in the program to gain insight about:
   a) Alignment of assessment questions with course learning outcomes
   b) Whether all the learning outcomes are tested; sometimes some learning outcomes are over tested at the expense of others which may be not tested at all.
   c) Overall weightage in the assessment, to each of Bloom's learning levels
   d) Assessment methods used to adequately assess the content and desired learning outcomes

   Based on the study, improvement priorities for each of the above factors need to be arrived

at. The reform process needs to be well planned and implemented through institutional strategy and communicated to all stakeholders particularly to the students.

3. A good and reasonable examination paper must consist of various difficulty levels to accommodate the different capabilities of students. Bloom's taxonomy framework helps the faculty to set examination papers that are well balanced, testing the different cognitive skills without a tilt towards a tough or easy paper perception. If the present examination questions are more focused towards lower cognitive skills, conscious efforts need to be made to bring in application skills or higher cognitive skills in the assessment. It is recommended that at institution/ University level, upper limit need to be arrived for lower order skills (for example, no more than 40% weightage for knowledge-oriented questions). It is important to note that, as nature of every course is different, the weightage for different cognitive levels in the question papers can also vary from course to course.

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 galvanization and tinning
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.
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. Summaries 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 " "?
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 nighttime 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. .

2. 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.

3. A ladder 5.0 m long rests on a horizontal ground & leans against a smooth vertical wall at an angle 200 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.

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.

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. 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 analyze 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%.

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?

7. Albert is working on a 32-bit machine whereas Julie is working on a 64-bit machine. Both wrote the same code to find factorial of a number, but Albert is unable to find factorial of a number till 9 whereas Julie can find the factorial of higher number. Identify the possible reason why Albert is unable to find the factorial. Suggest some changes in the code so that Albert 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 is 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 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 must 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.

SurTech

ASSESSING ABILITIES & PROFESSIONAL SKILLS OF STUDENTS

We can assess the students mainly in four modes: **Written Mode, Oral Mode, Practical Mode & Integrated Mode.**

Written Mode:
SE Exams
Class test
Self-test
Online test
Assignment
Report writing
Dissertations
Paper Review
Case Studies
Problem solving
MCQ
Open Book Test
Open Note Test
Essay writing
Annotated Bibliographies
Portfolios
MOOCs

Practical Mode:
Lab work
Comp. Sim. Work
Virtual Lab
Craft work
Co-Curriculars
Work experience

Oral Mode:
Viva /Oral Exam
One Question Quizzes
End of the Class Quiz
Think-Pair -Share
Group Discussion
Fishbowl technique
Role Play
Authentic Problem Solving
WSO (Watch Summaries Question)
Socratic Seminar
Grand Viva
Rapid Fire Questions
KWL (Know-Want To Know-Learned)

Integrated Mode:
Paper Presentations
Technical Seminar
SWOC Analysis
Authentic Problem Solving
Field assignments
Poster Presentation
Major & Minor Project
MOOCs
Portfolios

ASSESSING HIGHER-ORDER ABILITIES & PROFESSIONAL SKILLS

Professional skills (also known as soft skills, generic skills, or transferable skills) have become crucial traits of a graduating engineer in the twenty-first century. Industry/employers around the world regard these qualities more than disciplinary knowledge, according to studies. Six of the twelve NBA graduate qualities, namely (1) communication, (2) teamwork, (3) understanding ethics and professionalism, (4) knowing global and societal settings, (5) lifelong learning, and (6) knowledge of contemporary challenges, fall into this category. Furthermore, higher-order cognitive qualities such as critical thinking, problem-solving, and making well-informed judgments are required for a graduate to succeed in the new environment. Despite the fact that businesses value these professional qualities and better talents, pupils are lacking in them. The fundamental issue with them is that they are difficult to assess using the current traditional test system.

Innovative Educational Experiences to Teach and Assess

One of the most significant barriers to addressing these outcomes is the educational experience we provide in our engineering programmes. Because most of our programme's coursework focuses on imparting technical information and skills, the assessment is restricted to those competencies. Obtaining professional outcomes, on the other hand, may not be the result of simply taking a class or a collection of classes. Rather, these outcomes are acquired or impacted by a variety of sources both inside and outside the classroom.

To overcome these issues, we need to make significant changes to the way we construct our curriculum, student learning experiences, and outcome evaluation. Several attempts are being made around the world to address these issues. The following are a few recommended educational experiences for teaching and assessing professional results and higher-order cognitive abilities:

- Course projects
- Open-ended experiments in laboratories
- Project-based learning modules
- MOOCs
- Co-Curricular experiences
- Mini / Minor projects
- Final year projects
- Internship experiences
- E-portfolios of student works

Using Scoring Rubrics as Assessment Tool

It is critical to have reliable techniques / suitable evaluation tools to evaluate the, as students attempt to achieve course goals and hence POs. Rubrics are an effective tool for evaluating and assessing student work. They can also act as a transparent and motivating learning guide. Rubrics are grading tools that are used to assess a student's performance and learning based on a set of

criteria and objectives. Rubrics communicate your assessment expectations to students (and other markers) as well as what you value.

Within rubrics, there are three components: I criteria/performance Indicator: (i) the aspects of performance that will be evaluated, (ii) descriptors: characteristics associated with each dimension, and (iii) scale/level of performance: a rating scale that defines students' level of mastery within each criterion.

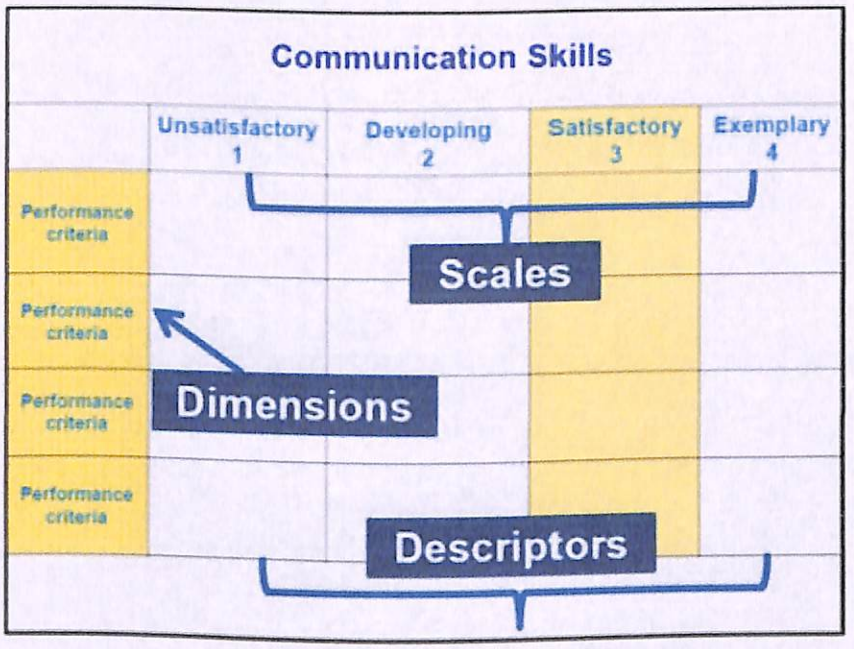


Fig. 4: Examples of Rubrics (Accessed from Rogers 2010)

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

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
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:				

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

SurTech

MODEL QUESTION PAPER FOR END SEMESTER EXAMINATION

Course Name: Programming for Problem Solving
Duration: 3 hrs. ; Max. Marks: 100

Instructions:

a. Attempt five questions selecting ONE from each section. Question 9 (Section E) is compulsory.

b. All the questions carry equal marks.

c. Draw neat diagrams wherever applicable.

Q. No	Question	Marks	BL	CO	PO	PI Code
	Section-A					
1.	a. What is an algorithm? Explain the characteristics of an algorithm.	2+6	1,2	2	1	1.4.1
	b. Write an algorithm to find angle between hour and minute hands of a clock at a given time.	7	3	3	1	1.4.1
	c. Is it mandatory to declare main() function with return type as void or int. What will be the effect if there is no return type declared for main() function?	3+2	4	3	1	1.4.1
	OR					
2.	a. What is the difference between definition and declaration in C? When a user writes "int x;" is it treated as declaration or definition in C.	3+2	2,4	3	1	1.4.1
	b. Write a program in C to find largest of 3 positive integer numbers using conditional operators.	7	3	3	1,2	1.4.1, 2.2.4
	c. What is meant by iterative statements? What are the different types of iterative statements in C?	8	1,2	3	1	1.4.1
	Section-B					
3.	a. Bob has placed N objects in a row which are marked with a number equal to their weight in Kg. He wants to check whether the objects are in increasing order of their weights or not. Write a C program to help Bob.	12	3	3,6,7	1,2	1.4.1, 2.2.4
	b. Differentiate between Big-O and Big-Omega notation.	4	2	3	1	1.4.1
	c. What is the role of index in an array? How are the elements of a 2D array accessed in C?	2+2	2	3	1	1.4.1
	OR					
4.	a. Ram is conducting a study which is based on counting the number of cars crossing the highway. Every hour he generates a random string containing sequence of characters <rbwbwr...>, where r represents red color, w denotes white color and b denotes blue color cars. The string is forwarded to Shyam for analysis who computes the number of red, blue and white color cars crossing Ram every hour. Assume that Ram works for 5 hours in a day, help Shyam generate a daily report containing the following: i. Total number of different colour cars crossing Ram in an hour. ii. Total number of different colour cars crossing Ram in a day. iii. Total number of cars crossing Ram in a day.	4+4+4	3	3,6,7	1,2	1.4.1, 2.2.4

	b. What is a variable? Explain the ways to declare scope of a variable.	2+6	1,2	3	1	1.4.1
	Section-C					
5.	a. Write a program which will read positive integer numbers from the users and compute the sum if the number can be expressed as power of 2. The test whether a number can be expressed as power of 2 will be done using a function power_of_two(int a).	12	3	3,6,7	1,2	1.4.1
	b. What is recursion? Differentiate between homogeneous and heterogeneous recursion with the help of an example.	2+3+3	2	3	1	1.4.1
	OR					
6.	a. What are the different ways to pass parameters to a function? Explain with the help of a suitable example.	4+4	2	3,5	1	1.4.1
	b. Is it possible to return multiple values from a function? Justify the statement with the help of an example.	4+8	3	3,6,7	1,2	1.4.1
	Section-D					
7.	a. What is a structure? What is the benefit offered by using a structure over multiple arrays?	2+6	2	5	1	1.4.1
	b. Ram is working on a project which requires returning multiple values from a function. He observed that a return statement can only be used to return a single value from a function. How the function should be implemented so that multiple values can be returned by Ram?	12	4	5	1	1.4.1
	OR					
8.	a. Write a program that reads a number as input from the user. The entered number is written to a file "even.txt" if the input is even else it is written to "odd.txt". Write a C code to perform the desired task.	12	3	5	1	1.4.1
	b. What are the different methods to open a file? Explain each with the help of a C program.	3+5	2	5	1	1.4.1
	Section-E (Compulsory Question)					
9.	a. What is a compiler? List names of any 2 compilers.	2 ½	1	1	1	1.4.1
	b. What are the benefits of designing a flowchart for solving a problem?	2 ½	4	2	1	1.4.1

	c. What is the output of the following code?
	int main(){
	int x=10;
	int y=sizeof(x/2);
	printf("%d",y); }
		2 ½	3	4	1	1.4.1

	d. What is the difference between creating constant using #define macro and const keyword?	2 ½	3	3	1	1.4.1
	e. What is the role of function prototype? When is it required in C?	2 ½	2	3	1	1.4.1
	f. Which of the following are unary operators in C? State reason for your answer. a. ! b. sizeof c. ~ d. &&	2 ½	2	3	1	1.4.1

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	g. Which of the following special symbol allowed in a variable name? State reason for your answer. a. * (asterisk) b. | (pipeline) c. - (hyphen) d. _ (underscore)	2 ½	2	3	1	1.4.1
	h. In which header file is the NULL macro defined? State reason for your answer. a. stdio.h b. stddef.h c. stdio.h and stddef.h d. math.h	2 ½	2	3	1	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

Modern methods of the CIE & SEE assessment in various programs in our College

01 Continuous Evaluation system

02 Open-ended problem-solving & assignments

03 Case Study

04 Term papers & Course Project Rubrics

05 Grand Viva & Oral Exam /Viva Voce

06 Written Examination

07 Quiz Contest & Debate Contest

08 MOOCs

09 Choice Based Credit System

10 Open Book Examination

11 MCQ based Examinations

12 Essay Writing Examinations

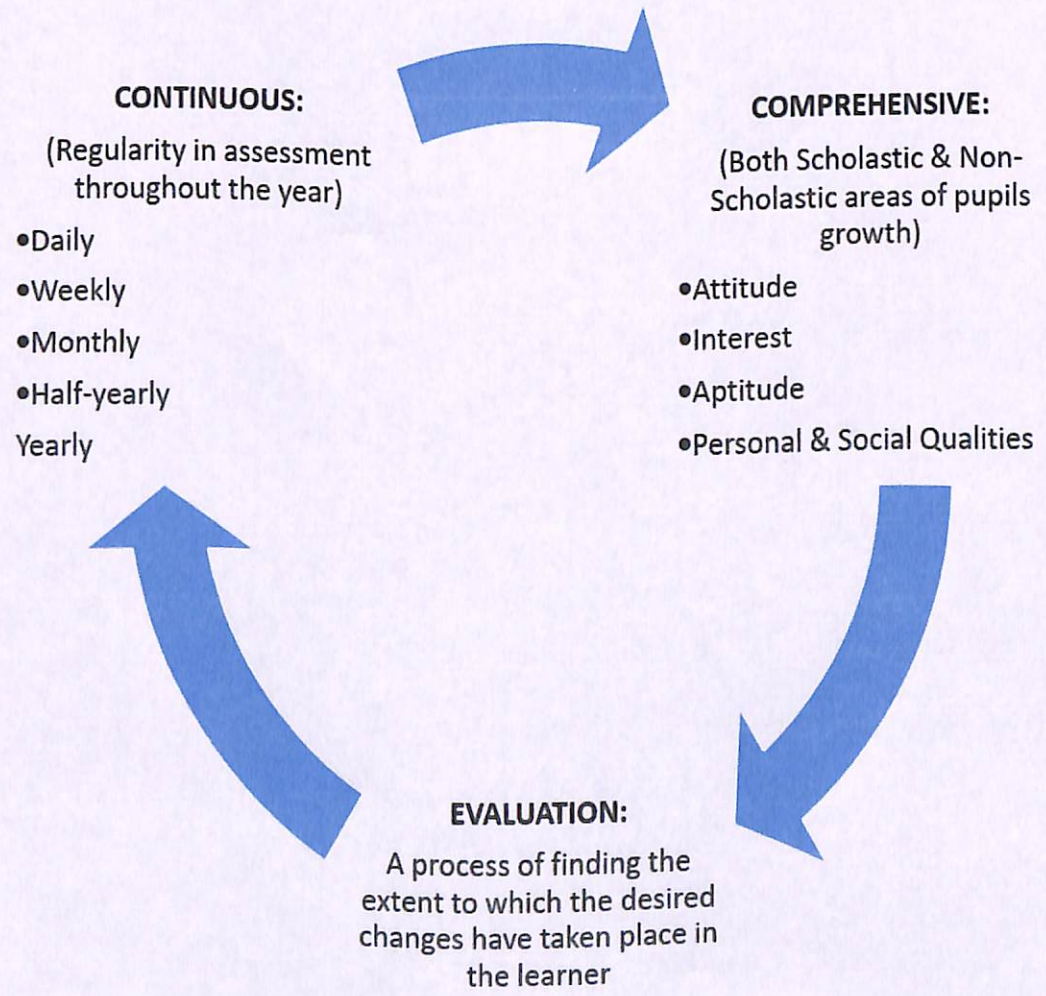
Continuous Evaluation System

Continuous and Comprehensive Evaluation (CCE) system is useful to assess all aspects of a student's development on a continuous basis throughout the year.

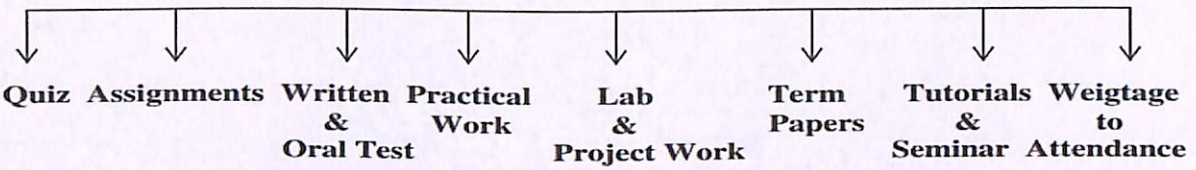
The assessment covers both scholastic subjects as well as coscholastic areas such as performance in sports, art, music, dance, drama, and other cultural activities and social qualities.

The main aim of CCE is to reduce pressure on students who are unable to effectively participate in the educational system and leave it dejected and with low self-confidence.

Students are required to participate in activities even if the syllabus is not covered.



Components of Continuous and Comprehensive Evaluation



Scholastic subjects are assessed using two modes: Formative Assessment (FA) and Summative Assessment (SA).

Formative evaluation helps in strengthening and improving the object being evaluated by examining the delivery of the program, the quality of its implementation, and the assessment of the context, procedures, inputs, etc.

Formative evaluation is conducted to monitor instructional processes to determine whether learning is taking place as planned.

It is concerned with judgments made during the testing or the development of a programme which is directed towards modifying, forming or improving the programme.

It considers smaller and independent units of the curriculum.

At the end of every unit, students should be given test for diagnosis.

These tests are used to make the process of teaching-learning highly effective.

It provides continuous feedback to both pupil and teacher concerning success and failure of the learning process.

Formative Assessment usually comprises of Class Tests, Homework, Quizzes, Projects, and Assignments directed throughout the year.

A summative evaluation examines the outcomes of the learners.

Summative evaluation is conducted at the end of the semester/ End of the Unit or Module after completion of the entire Unit/Module & Course.

It evaluates the achievements of education and is designed in such a way as to determine the extent to which the behavioral modification takes place in an individual.

Achievement tests and annual examinations are the various types of tests used in summative evaluation.

It is a later process that occur at the end of the academic session to measure the achievement of the pupils.

Evaluation of Scholastic Areas:

	Term 1			Term 2		
	FA1	FA2	SA1	FA3	FA4	SA2
Weightage	10%	10%	30%	10%	10%	30%
Term Weightage	FA1+FA2+SA1=50%			FA3+FA4+SA2=50%		

Total: Formative Assessments (FA) = FA1+FA2+ FA3+FA4 = **40%**
Summative Assessments (SA) = SA1+SA2 = **60%**
Scholastic Assessment grades are generally given on a 9-point grading scale.

Evaluation of Co-Scholastic Areas:

Co-Scholastic areas are assessed using multiple techniques based on specific criteria.

Assessment of co-scholastic areas are done at the end of the year, and grades are generally given on a 5-point grading scale.

Minute Papers Examination

At the end of a class, instructors can ask students to write for a minute or two on one of the following kinds of questions:

"What is the most significant thing you've learned today?"

"What points are still not clear?"

"What question is uppermost in your mind at the end of today's class?"

Responses can help instructors evaluate how well students are learning the material.

Class Test

This type of test includes all types of questions-essays, short answer, objective, Design in test all levels of cognitive domain; Exam Blueprint be prepared to ensure inclusion of all types & levels of questions and proper sampling of content. Rubrics (with detailed indicators of level wise performance) & Model Answers for making essay type questions for minimizing subjectivity; Making Criteria made known to students; Teacher should provide written feedback selectively & discuss answers in the class; Only Role/Code numbers, not names be written to avoid bias in marking; display of model answer copies.

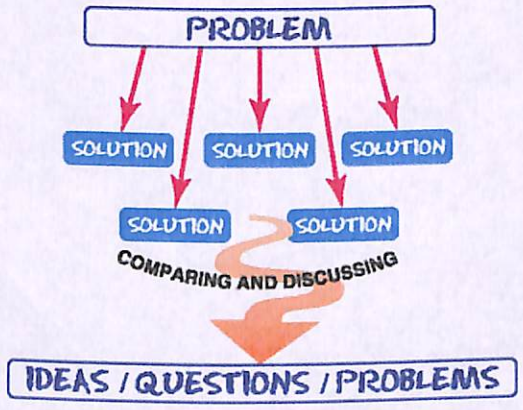
Open-ended problem-solving & assignments

Open-ended problem is a problem that has several or many correct answers, and several ways to the correct answer(s).

The Open-Ended Approach provides students with "experience in finding something new in the process"

Open-Ended problems are also used as assessment tasks because "In responding to such (open-ended) items, students are often asked not only to show their work, but also to explain how they got their answers or why they chose the method they did".

The Open-Ended Problem Solving also has been widely regarded as an advanced style of teaching mathematics in the U.S. & Japan recent years.



The assignments will be checked, and feedback will be given to the students, either by the instructor, or by a designated grader (usually a graduate student) - but under the instructor's close supervision.

The letter grade (from F=failed to A=very good) weighs the various numerical grades (how many correct solutions one gives).

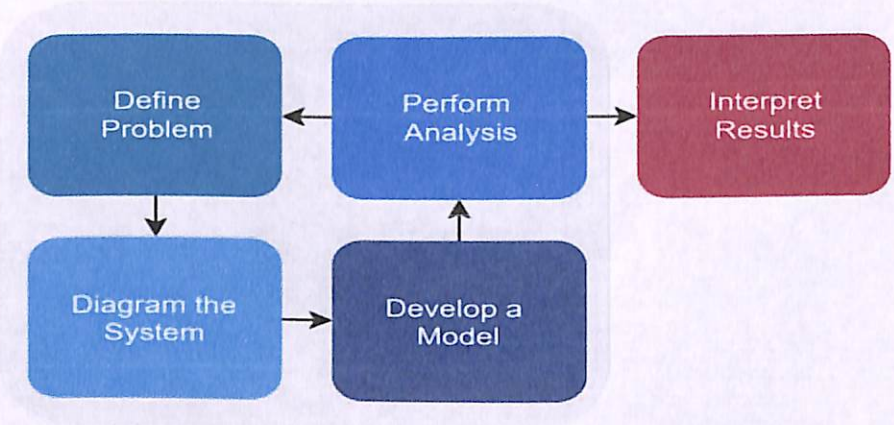
Case Study

A case study is an in-depth study of one person, group, or event.

In a case study, nearly every aspect of the subject's life and history is analyzed to seek patterns and causes of behavior.

Case studies can be used in a variety of fields including psychology, medicine, education, anthropology, political science, and social work.

Process diagrams for engineering case analysis



Case Study Evaluation Criteria

- User needs,
- Study design,
- Data characteristics and quality,
- Data management, and
- Institutional issues.

USER NEEDS

The term "user needs," refers to needs to find, evaluate, access, transfer, and/or combine data.

It also refers to requirements for manipulating, processing, analyzing, or otherwise working with the data.

Finally, it refers to the necessity for users to respond to institutional or cultural constraints, motivations, or pressures.

Identifying Users

- Was there a clear definition of users and user groups at the inception of the research project?
- Were users at each step of the data path, from initial data collection to final analysis and archiving, clearly defined?

Understanding Users' Requirements

- Were the specific requirements of users at each step of the data path clearly defined?
- Were future potential users' needs predicted and accommodated?
- Were there incompatibilities or conflicts among different user groups?
- Were institutional structures and management mechanisms (*committees, working groups*) established to identify users' needs and resolve conflicts?
- Did users feel as if their needs were accommodated? If not, why not?

Technical Aspects

- Did the study create specialized algorithms, routines, data management procedures, or database structures to accommodate users' needs? If so, how successful were they?
- Did the study, as originally envisioned, require interfacing disparate databases?
- Were interfacing requirements and issues understood and allowed for?

STUDY DESIGN

Conceptual Framework

- Was the study based on an overall conceptual model that described the relationships (both theoretical and functional) among different data types?
- Was the conceptual framework pursued to a level of detail that helped identify data interfacing issues?
- Was the conceptual framework explicitly multidisciplinary and multimedia?

Methodological Issues

- Was the study an interdisciplinary one involving multiple data types?
- Were all relevant disciplines and data types identified at the beginning of the study, or were midcourse adjustments required?
- Were pilot studies performed to assess potential data integration issues and solutions?
- Were data integration issues identified and planned for in the initial phase of the study? If not, at what stage of the study where they considered?

- Were methodological differences among study components that created difficulties in later integration identified at the outset of the study?
- What changes would the participants make in the study design if they had the opportunity to begin over again?

Data Integration

- Did the study design involve using preexisting data? If so, what problems were encountered? Were enough metadata available?
- Were there technical differences among disciplines that created data integration problems, e.g., requirements for different spatial scales or levels of detection?
- What kind of data integration did the study's data analyses require? Were these based on the study's underlying conceptual model and were they allowed for in the study design?

DATA CHARACTERISTICS AND DATA QUALITY

Data Characteristics

- Were data characteristics sufficiently documented in the metadata? If not, how difficult was it to find needed information about the data?

Quality Control

- If historical data were used, what quality control problems were encountered and how were they resolved?
- Were potentially problematic data characteristics known beforehand or discovered in the data integration process?
- How were differences in data quality among data sets handled?
- Were data quality procedures considered an integral part of data integration?
- How were data verified and validated?

Data Integration

- What specific data characteristics created data interfacing problems?
- What was the source(s) of these problems?
- Were there data formatting or quality standards that proved useful?

- What lessons were learned that would be applicable to other studies?

DATA MANAGEMENT

Data management refers to the provisions for handling the data at each step of the data path, from initial study design, through data collection, accessing, and analysis, to final reporting and archiving.

It refers not only to specific technical procedures, but also to the plan for ensuring the original quality of the data and preventing their degradation over time.

Data management plans should include organizational plans that specify data management functions and who has responsibility for data quality at each step of the data path.

Up-Front Planning

- Was there an overall data management plan that supported the data integration process?
- What provisions were made for data access, retrieval, and manipulation?
- Were data management procedures designed to relate directly to technical issues involved in data integration?
- Were quality control issues considered in all data management procedures?
- Were archival needs considered at the beginning of the study?

Data Management Procedures

- Were specific database tools developed to aid the database interfacing process?
- Are there readily identifiable authorized versions of the different data sets? If so, how are these maintained?
- What provisions were made to make metadata available to users?
- Did data management requirements related to database interfacing add to project overhead?
- Did data integration directly benefit project participants?
- How accessible were the data?
- Were there any restrictions on use of the data? If so, what was the source of these restrictions?

Planning for the Future

- Did data management procedures and systems explicitly consider future potential needs?
- What arrangements were made for archiving the data for future uses?
- Where are the data now and are they easily accessible? Are metadata readily available for future users?
- How easy would it be to transfer existing data to different database systems?
- What changes would the participants make in the data management plan if they had the opportunity to begin again?

INSTITUTIONAL ISSUES

Institutional issues often have an overriding influence on the success of data integration efforts, yet they can be difficult to identify and resolve.

These issues arise, for example, from differences in agency missions and mandates, from funding restrictions, from differences in time horizons and constituencies, and from differences in organizational cultures.

Participants

- Who were the key participants and what were their roles, responsibilities, and authority?
- What was the nature of the key participants, e.g., private, governmental?
- Were key players or data sources missing from the study?
- Did any participants place special conditions on their participation and/or on access to data, e.g., proprietary data?

Organization and Management

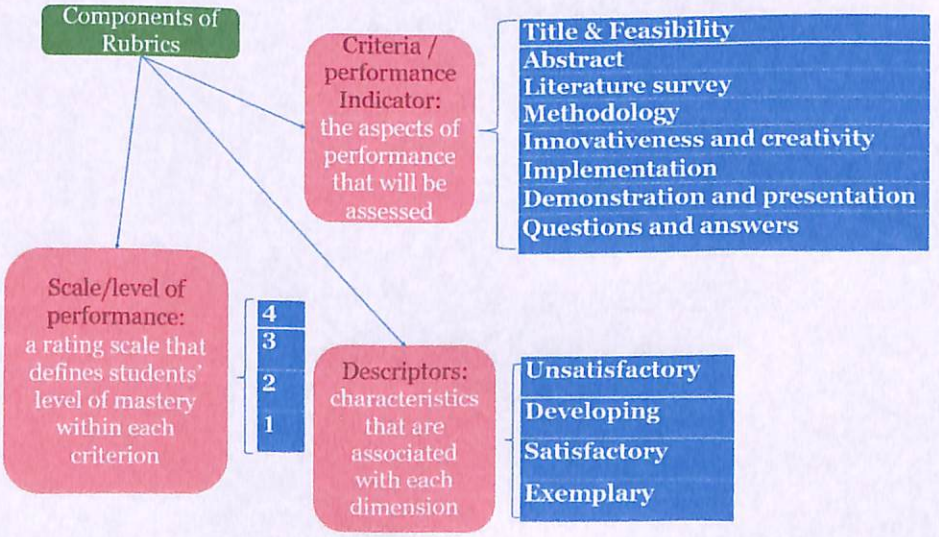
- What was the project's management structure, especially with regard to database interfacing? Was there a lead entity?
- Did the study's organizational structure support or impede database interfacing?
- What arrangements were made among the participants with regard to database interfacing? Were these formal or informal?
- What was the decision-making process, again especially with regard to database interfacing?
- What kinds of arrangements were made for acquiring data from other organizations?

- Was adequate funding available and committed for the duration of the study?
- Was there a long-term commitment to database updating and other maintenance?
- Who can access the data now and are there any restrictions on this
- What agency, if any, was given responsibility for long-term management and maintenance of the data?

Data Integration

- Did all participants agree with the need for data integration?
- What mechanisms were established for cooperation and data integration? Were any of these novel?
- Were potential conflicts and disagreements clearly identified and negotiated at the beginning of the study?
- Did agency missions, mandates, and policies restrict participation or otherwise impede database interfacing?
- Did existing data management practices impede data integration?

Term papers & Course Project Rubrics



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
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.

Using Scoring Rubrics as Assessment Tool

	Indicator	Inadequate(1)	Average(2)	Good(3)	Outstanding(4)	Mark selected	Weightage	Marks Obtaied
Knowledge and Content	Organization of presentation	Hard to follow; sequence of information jumpy	Most of information presented in sequence	Information presented in logical sequence; easy to follow	Information presented as interesting story in logical, easy to follow sequence	4	3	100
	Background content	Material not clearly related to topic OR background dominated seminar	Material sufficient for clear understanding but not clearly presented	Material sufficient for clear understanding AND effectively presented	Material sufficient for clear understanding AND exceptionally presented	4	3	
	Methods	Methods too brief or insufficient for adequate understanding OR too detailed	Sufficient for understanding but not clearly presented	Sufficient for understanding AND effectively presented	Sufficient for understanding AND exceptionally presented	4	3	
	Results (figures, graphs, tables, etc.)	Some figures hard to read Some in inappropriate format Some explanations lacking	Majority of figures clear Majority appropriately formatted Reasonably explained	Most figures clear Most appropriately formatted Well explained	All figures clear All appropriately formatted Exceptionally explained	4	3	
	Knowledge of subject	Does not have grasp of information; answered only rudimentary questions	At ease with information; answered most questions	At ease; answered all questions but failed to elaborate	Demonstrated full knowledge; answered all questions with elaboration	4	3	
Presentation Skills	Graphics (use of Powerpoint)	Uses graphics that rarely support text and presentation	Uses graphics that relate to text and presentation	Uses graphics that explain text and presentation	Uses graphics that explain and reinforce text and presentation	4	2	
	Mechanics	Presentation has more than 10 misspellings and/or grammatical errors	Presentation has no more than 5 misspellings and/or grammatical errors	Presentation has no more than 2 misspellings and/or grammatical errors	Presentation has no misspellings or grammatical errors	4	2	
	Eye Contact	Reads most slides; no or just occasional eye contact.	Refers to slides to make points; occasional eye contact	Refers to slides to make points; eye contact majority of time	Refers to slides to make points; engaged with audience	4	2	
	Elocution - ability to speak English language	Mumbles and/or Incorrectly pronounces some terms Voice is low; difficult to hear	Incorrectly pronounces some terms Voice fluctuates from low to clear; difficult to hear at times	Incorrectly pronounces few terms Voice is clear with few fluctuations; audience can hear well most of the time	Correct, precise pronunciation of all terms Voice is clear and steady; audience can hear well at all times	4	2	
	Length and Pace	Short; less than 30 min Rushed OR dragging throughout.	Short 40 min OR long >50 Rushed OR dragging in part	Adequate 40-45 min Most of the seminar well paced.	Appropriate (45-50 min) Well-paced throughout	4	2	

PROJECT

RUBRICS FOR REVIEW – I

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%
2.1.1	Articulate problem statements and identify objectives - GA	02	Problem statement and objectives are not identified	Problem statement and objectives are not clear	Problem statement is clear and objectives are not in line with problem statement	Problem statement is clear and objectives are not completely defined.	Problem statement is clear and objectives are completely defined
2.1.2	Identify engineering systems, variables, and parameters to solve the problems - IA	02	Engineering systems are not identified. Variables, and parameters to solve the problems are not defined	Engineering systems are identified but not clear. Variables, and parameters to solve the problems are not defined	Engineering systems are clear. Variables, and parameters to solve the problems are not defined	Engineering systems are identified. Variables, and parameters to solve the problems are partially defined	Engineering systems are identified. Variables, and parameters to solve the problems are completely defined
2.2.3	Identify existing processes/ solution methods for solving the problem, including forming justified approximations and assumptions - GA	02	Not able to identify existing solution for solving the problem. The assumptions, approximations and justifications are also not identified.	Not able to identify existing solution for solving the problem. The assumptions, approximations and justifications are identified but not clear	Not able to identify existing solution for solving the problem. But assumptions and approximations are aligned to the objectives.	Able to identify existing solution for solving the problem. Assumptions, and approximations are clear	Able to identify existing solution for solving the problem. But assumptions, approximations and justifications are clear
2.2.4	Compare and contrast alternative solution processes to select the best process - GA	02	Not able to identify alternative solution processes	Not able to compare alternative solution processes	Able to compare alternative solution processes but could not contrast clearly	Able to compare alternative solution processes and contrast clearly but not able to select best process	Able to compare alternative solution processes, contrast it and also able to select best process
10.1.1	Read, understand and interpret technical and non-technical information - GA	02	Not able to identify technical and non-technical information	Able to identify non-technical information	Able to read technical and non-technical information, but could not understand and interpret	Able to read, understand technical and non-technical information, but could not interpret	Able to read, understand and interpret technical and non-technical information

GA – Group Assessment IA – Individual Assessment

RUBRICS FOR REVIEW – II

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%
3.2.1	Apply formal idea generation tools to develop multiple engineering design solutions - GA	02	Not able to identify tools to develop solutions	Able to identify but not able to use it effectively	Able to use the tool but not able to generate engineering designs	Able to generate engineering designs but not able to justify	Able to generate engineering designs with justification
3.2.3	Identify suitable criteria for evaluation of alternate design solutions - GA	02	Not able to identify criteria	Able to identify criteria but not able to use them	Able to use criteria but not able to compare alternatives	Not able to justify the comparison with criteria	Able to justify the comparison with criteria
3.3.1	Apply formal decision-making tools to select optimal engineering design solutions for further development - GA	02	Not able to identify decision-making tools	Able to identify but not able to choose optimum one	Able to identify optimum one but not able to use it	Able to use optimum one but not able to justify	Able to use optimum one with justification
3.2.2	Build models/ prototypes to develop diverse set of design solutions - IA	02	Not able to identify tool to build model/ prototype	Able to choose the tool but not able to use it effectively	Able to use the tool but not able to generate alternatives	Able to generate alternatives but not able to justify the best solution	Able to generate and justify the best solution
13.1.1	Develop 2D drawings of components/ systems using modern CAD tools - IA	02	Not able to identify CAD tools	Able to identify but not able to use CAD tool	Able to use CAD tool but not able to generate drawings	Able to generate drawings but not able to follow drawing standards	Able to generate drawings with standards
13.1.2	Develop 3D models of components/systems using modern CAD tools - IA	03	Not able to identify CAD tools	Able to identify but not able to use CAD tool	Able to use CAD tool but not able to generate 3D models	Able to generate models but not able to follow standards	Able to generate models with standards
13.1.3	Apply GD&T principles as per ASME standards to manufacturing drawings, with all relevant data like material, hardness, surface finish, and tolerances - IA	02	Not able to extract GD&T principles from ASME standards	Able to extract but not able to understand them	Able to understand but not able to apply GD&T standards	Able to apply GD&T standards to drawings but not able to justify	Able to apply and justify GD&T standards to drawings

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%
3.4.2	Generate information through appropriate tests to improve or revise design - GA	02	Not able to identify suitable tests to be done	Able to identify but not able to follow testing procedure	Able to follow testing procedures but not able to collect information	Able to collect information but not able to apply it for improvement	Able to apply information for the improvement
4.3.1	Use appropriate procedures, tools and techniques to conduct experiments and collect data - GA	04	Not able to identify tools, techniques and procedures	Able to identify but not able to conduct experiments	Able to conduct experiments but not able to follow procedure	Able to follow procedure but not able to collect data	Able to collect data as per the standards
4.3.2	Analyze data for trends and correlations, stating possible errors and limitations - GA	03	Not able to understand data	Able to understand but not able to analyze data	Able to analyze data but not able to correlate them	Able to correlate but not able to identify errors and limitations	Able to identify errors and limitations
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.

Grand Viva & Oral Exam /Viva Voce

Oral examination or viva-voce is used mainly to test the cognitive domain and is conducted with the aim of evaluating the qualities like depth of knowledge, ability to discuss and defend one's decision, attitudes, alertness, ability to perform under stress and professional competence.

The oral exam (also oral test or *viva voce*) is a practice in many schools and disciplines in which an examiner poses questions to the student in spoken form.

The student must answer the question in such a way as to demonstrate sufficient knowledge of the subject to pass the exam.

The oral exam also helps reduce (although it does not eliminate) the risk of granting a degree to a candidate who has had the thesis or dissertation by an expert.

The Conventional Viva-voce examination (CVE) is fraught with subjectivity and has been found to have poor validity, reliability, and objectivity.

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.
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.

A Structured Viva-voce Examination (SVE) using card system for the viva-voce was designed for the semester term ending examinations for students.

A. Subject/ Course Based card System

B. Module based Card System

C. Topic based Card System

Implementation Procedure:

1. Based on the syllabus and after due weightage to the various topics as per the curriculum prescribed by the Department, questions were framed under all modules.

2. The questions were developed with graded levels of difficulty for different topics of the examination.

3. The questions were subjected to peer review and finalized with approval of head of the department.

4. Cards were designed with questions written on them.

5.The students were briefed about the system prior to the examination and consent was obtained.

6.The viva was conducted by two faculty members. Each faculty dealt with five topics.

7.At the viva 10 sets for each Module of cards were laid out on the table. Each set had two subsets a) direct questions b) applied questions.

9.The student began from any of the major categories and randomly chose a fixed number of cards from each topic sequentially and attempted to answer the same.

10.Depending on the initial response of the student, he/she was encouraged to respond to questions of lower or higher level of difficulty as the case maybe to assess the level of student's knowledge.

Also, a mix of direct questions and applied questions from the two subsets was used.

Conventional Viva-voce Examination:

Sl	Statements
1	Examiners can be moody affecting performance
2	Examiners tend to skip some topics, hence incomplete
3	Tendency to be biased
4	Focus too much on one topic especially of their interest
5	Proceed haphazardly
6	Questions are predictable

Structured Viva-voce Examination:

1	Covers all topics, hence comprehensive evaluation
2	Eliminates subjective bias
3	Minimizes chances of repetitive questions for subsequent students
4	Helps to focus on one topic at a time
5	Students get more time to think
6	Helps student perform better
7	Is student friendly
8	Helps maintain chain of thought because of sequential questions

Written Examination

In Indian engineering education system, written examinations play a major role in assessing the learning and awarding of grades to the student

Universities and colleges give highest weightage to the outcomes of the written examinations in overall grading.

Questions raised in the examination/test papers play an important role in defining the level of learning the student is expected to achieve in the courses and hence in the program.

Since assessment drives learning, the design of question papers needs to go beyond the mere test of memory recall.

Written examinations assess a very limited range of outcomes and cognitive levels.

Particularly in the courses, where course outcomes (COs) cover a broad range of expectations, written examinations alone will not be sufficient to make valid judgements about student learning.

Quiz Contest & Debate Contest

This type of tests can be conducted 4 per semester including 1 Makeup & 1 Surprise Quiz; Also valuable as 'End of the class quiz'.

Teachers be trained in construction, advantages and precautions while preparing different types of objective items; Balance between recognition and recall types; Go beyond factual information to HOT skills.

Debate Contest: Levels of Performance for AFFIRMATIVE & NEGATIVE Team

Criteria	4	3	2	1	Grade:
Organization & Clarity: Main arguments and responses are outlined in a clear and orderly way.	Completely clear and orderly presentation	Mostly clear and orderly in all parts	Clear in some parts but not overall	Unclear and disorganized throughout	
Use of Argument: Reasons are given to support the resolution	Very strong and persuasive arguments given throughout	Many good arguments given, with only minor problems	Some decent arguments, but some significant problems	Few or no real arguments given, or all arguments given had significant problems	
Use of cross-examination and rebuttal: Identification of weakness in Negative team's arguments and ability to defend itself against attack.	Excellent cross-exam and defense against Negative team's objections	Good cross-exam and rebuttals, with only minor slip-ups	Decent cross-exam and/or rebuttals, but with some significant problems	Poor cross-exam or rebuttals, failure to point out problems in Negative team's position or failure to defend itself against attack.	
Presentation Style: Tone of voice, clarity of expression, precision of arguments all contribute to keeping audience's attention and persuading them of the team's case.	All style features were used convincingly	Most style features were used convincingly	Few style features were used convincingly	Very few style features were used, none of them convincingly	
					TOTAL SCORE:

MOOCs

MOOCs: Massive Open Online Courses (MOOCs) are such online courses which are developed as per the pedagogy stated herein and following the four-quadrant approach consisting of video , text, self-assessment and learn more.

There is two types of Courses: credit courses and non-credit courses.

Credit Course shall mean a course which is taught for at least one semester as a part of a PG Programme in Indian Universities.

Non-Credit Course shall include courses like awareness programme, continuing education programme or of specific skill set as independent course, which are not part of any set curriculum.

Subject: shall mean a specific area under a discipline (Example: Physics) taught in an educational institution consisting of specific programme/ courses, resulting in the award of a certificate/ diploma/ degree shorter duration.

After clearing the Online Course by a Student of an University/ Institute, then the University/ Institute should issue certificate(s) and 'Transfer the Credits' to registered Students under SWAYAM that are existing as regular & enrolled students from a recognized University/Institute across the country and shall follow, the UGC (Credit Framework for Online Learning Courses through SWAYAM) Regulation, 2016, a 'Gazette Notification' issued on 19th July, 2016.

Credit Allocation:

A 1 to 3 credit SWAYAM course is expected to be covered in 4-12 weeks' duration including the assessment component in which (it should be 40 hours (for 3 credit course) to 80 hours (for a 6-credit course) of learning from e- Content, reading reference material, discussion forum posting and assignment.

For other MooC Courses, One credit will be equivalent to 10 hours of learning including participating in discussion forums and other interactions, working on assignments and activities designated for the course etc.

Choice Based Credit System

Majority of Indian higher education institutions have been following marks or percentage-based evaluation system, which obstructs the flexibility for the students to study the subjects/courses of their choice and their mobility to different institutions.

There is need to allow the flexibility in education system, so that students depending upon their interests and aims can choose interdisciplinary, intra-disciplinary and skill-based courses.

This can only be possible when choice-based credit system (CBCS), an internationally acknowledged system, is adopted.

The choice-based credit system not only offers opportunities and avenues to learn core subjects but also exploring additional avenues of learning beyond the core subjects for holistic development of an individual.

To bring uniformity in evaluation system and computation of the Cumulative Grade Point Average (CGPA) based on student's performance in examinations, the UGC has formulated the guidelines to be followed:

Outline of Choice Based Credit System:

Core Course: A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.

Elective Course: Generally, a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/ subject of study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill is called an Elective Course.

Discipline Specific Elective (DSE) Course: Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective.

The University/Institute may also offer discipline related Elective courses of interdisciplinary nature (to be offered by main discipline/subject of study).

Dissertation/Project: An elective course designed to acquire special/advanced knowledge, such as supplement study/support study to a project work, and a candidate studies such a course on his own with an advisory support by a teacher/faculty member is called dissertation/project.

Generic Elective (GE) Course: An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective.

A core course offered in a discipline/subject may be treated as an elective by other discipline/subject and vice versa and such electives may also be referred to as Generic Elective.

Ability Enhancement Courses (AEC): The Ability Enhancement (AE) Courses may be of two kinds: Ability Enhancement Compulsory Courses (AECC) and Skill Enhancement Courses (SEC).

"AECC" courses are the courses based upon the content that leads to Knowledge enhancement; i. Environmental Science and ii. English / MIL Communication.

These are mandatory for all disciplines.

SEC courses are value-based and/or skill- based and are aimed at providing hands on-training, competencies, skills, etc.

Ability Enhancement Compulsory Courses (AECC): Environmental Science, English Communication/MIL Communication.

Skill Enhancement Courses (SEC): These courses may be chosen from a pool of courses designed to provide value-based and/or skill-based knowledge.

Introducing Research Component in Under-Graduate Courses Project work/Dissertation is considered as a special course involving application of knowledge in solving / analyzing /exploring a real-life situation / difficult problem. A Project/Dissertation work would be of 6 credits. A Project/Dissertation work may be given in lieu of a discipline specific elective paper.

Open-Book Examinations

The traditional written examinations have a significant weakness that they tend to encourage rote learning and more superficial application of knowledge.

This deficiency can be overcome by "open-book examination".

Open-book examination is like time constrained written examinations but designed in a way that allows students to refer to either class notes, textbooks, or other approved material while answering questions.

They are particularly useful if you want to test skills in application, analysis and evaluation, i.e. higher levels of Bloom's taxonomy.

However, in a program, the courses or the curriculum areas that are best suited to an open-book exam are to be carefully chosen.

Designing a good open-book examination

Set questions that require students to do things with the information available to them, rather than to merely locate the correct information and then summarize or rewrite it.

The questions in open-book exam must take advantage of the format, and give more weightage to the application of knowledge, critical thinking and use of resources for solving real complex engineering problems.

As the nature of questions is complex, it is to be ensured that the students get enough time.

Open book test questions typically take longer time compared to traditional examinations.

It is advisable either to set a smaller number of questions that encompass 2 or 3 concepts taught or allocate longer duration of time for the examinations.

Open Note Exams

Note making techniques be taught to students, Not just direct questions from notes, but application analysis and synthesis of that knowledge. One of the class tests or some class assignments could be of this type.

MCQ based Examinations

In a test that has items formatted as multiple-choice questions, a candidate would be given several set answers for each question, and the candidate must choose which answer or group of answers is correct.

There are two families of multiple-choice questions.

The first family is known as the True/False question, and it requires a test taker to choose all answers that are appropriate.

The second family is known as One-Best-Answer question, and it requires a test taker to answer only one from a list of answers.

There are several reasons to using multiple-choice questions in tests.

In terms of administration, multiple-choice questions usually require less time for test takers to answer, are easy to score and grade, provide greater coverage of material, allows for a wide range of difficulty, and can easily diagnose a test taker's difficulty with certain concepts.

As an educational tool, multiple-choice items test many levels of learning as well as a test taker's ability to integrate information, and it provides feedback to the test taker about why distractors were wrong and why correct answers were right.

Nevertheless, there are **difficulties** associated with the use of multiple-choice questions.

In administrative terms, multiple-choice items that are effective usually take a great time to construct.

As an educational tool, multiple-choice items do not allow test takers to demonstrate knowledge beyond the choices provided and may even encourage guessing or approximation due to the presence of at least one correct answer.

Moreover, test takers may misinterpret these items and, in the process, perceive these items to be tricky or picky.

Finally, multiple-choice items do not test a test taker's attitudes towards learning because correct responses can be easily faked.

Essay Writing Examinations

Items such as essay typically require a test taker to write a response to fulfill the requirements of the item.

In administrative terms, essay items take less time to construct.

As an assessment tool, essay items can test complex learning objectives as well as processes used to answer the question.

The items can also provide a more realistic and generalizable task for test.

Finally, these items make it difficult for test takers to guess the correct answers and require test takers to demonstrate their writing skills as well as correct spelling and grammar.

The difficulties with essay items are primarily administrative: for example, test takers require adequate time to be able to compose their answers.

When these questions are answered, the answers themselves are usually poorly written because test takers may not have time to organize and proofread their answers.

In turn, it takes more time to score or grade these items.

When these items are being scored or graded, the grading process itself becomes subjective as non-test related information may influence the process.

Thus, considerable effort is required to minimize the subjectivity of the grading process.

Finally, as an assessment tool, essay questions may potentially be unreliable in assessing the entire content of a subject matter.

Instructions to exam takers rely on the use of **command words** which direct the examinee to respond in a particular way, for example by describing or defining a concept, comparing two or more scenarios or events.

Annotated Bibliographic

It is a good test of students' abilities to scan and evaluate literature; Can stimulate higher order thinking skills as students review; stimulates group work and discussion; Good preparatory skill for research. The topics should be based on students' interests and course requirements; referencing skills be first taught to students.

Group tasks

Assessment types includes Group discussion, Flash bowl Technique, Role Play, Authentic Problem Solving.
Small group of 2-5 members work on a joint task.
Suggested frequency of this test is once every semester with one makes up and one term-end in certain courses.
Groups formed must be roughly equivalent; Problems assigned should be equivalent; Each team member must have a specific role; Rubrics for marking must be mutually decided including all domains of education.

Rapid fire questions

Questions on a topic asked very quickly and answered very fast.
It may be embedded in classroom teaching as required.
Student should be told the criteria of a good question; May be assessed by two evaluators for greater objectivity; May be recorded for closer assessment.

Field Assignments

It includes field / industry visit with report. Conducts once in a Semester.
Students must be exposed to note taking and report writing skills, if visiting different sites reports may be presented in class for sharing of experiences & learning.

Rules & Regulations of Examination guided by MAKAUT

4. Rules for examinations

4.1 Each discipline of the B.Tech / B.Pharm / B.Arch / B.Optm programme consists of the following three types of items:

- Theory items
- Practical items
- Sessional items

The schedule of these items along with their credit points for each semester shall be as point 5.

4.2 At the end of each semester, there shall be an examination (here-in-after called end-semester examination) conducted by the University as per programme announced by the Controller of Examinations.

4.3 Back paper examinations, if any, shall be held with the normal end-semester examination.

4.4 There shall be no separate supplementary examination under normal condition for I/II/III year B.Tech/B.Pharm students (I/II/III/IV year B.Arch students). For the purpose of degree only supplementary examination for both 7^{th} and 8^{th} semester (9^{th} and 10^{th} semesters for B.Arch programme) shall be held within one month of the publication of final semester examination results.

5. Evaluation of course items

The evaluation of course items listed in para 4.1 shall be done as per the following guidelines:

(A) Theory Items

Each item under this classification shall be evaluated on the basis of 100 percentage points, sub-divided into the following four categories:

a) End-Semester examination: 70 points

Operational Guidelines:

i. A group of examiners drawn from the affiliated,institutions/colleges shall be appointed by the University for each theory subject.
ii. A 'Subject Examination Committee' consisting of an Expert Member from outside the affiliated institutions/colleges, a senior faculty from an affiliated institution and a faculty actually conducting the course shall be constituted by the University for each theory subject and duly ratified by the Advisory Committee/Academic Council. The Subject Examination Committee shall ensure uniformity in grading through spot/random checking, especially for candidates with very high grades/very low grades.
iii. The University shall follow a centralized evaluation system.
iv. Correction/Evaluation of scripts shall be completed, and award list submitted within a reasonable time after the completion of the examination as decided by the University.
v. The entire evaluation work shall be completed within a reasonable time after the completion of the examination as decided by the University.

b) Course tests/class tests: 15 points

Operational Guidelines:

i. Three tests shall ordinarily be conducted, as far as possible, at near-identical intervals by the course teacher. The best two performances shall only be considered for final reckoning.
ii. The Director/Head of the Department shall ordinarily set the test schedule and announce test dates as per University calendar.
iii. Test scripts shall be corrected/evaluated within seven days of actual conduct of test and the solutions discussed in the class. During- the discussions the students shall have access to the corrected scripts. The final award list for each test shall be put on the notice board within the next two days and copies communicated to the Director/Principal for record.
iv. The process shall be repeated for each test.

c) Quizzes and Assignments: 10 points

Operational Guidelines:

At least 3 to 4 unannounced quizzes shall be conducted by the course teacher during the lecture/tutorial class and suitable number of home assignments shall be insisted upon. The course teacher shall be solely responsible for final award under this category.

d) Attendance regularity and participation: 5 points

Operational Guidelines:

The award under this category shall be the sole prerogative of the Course teacher. Whereas attendance/regularity in a class is factual, assessment about participation is subjective. The idea is

to encourage teacher/student interaction in Conduct of Courses and discourage one-way communication.

The Course teacher shall finalise the award of a student (out of 30, comprising b), c) and d) and communicate the award list to the University (Controller of Examinations' unit) under sealed cover, with a scaled copy to the Director/Principal of the Institute for records and reference under unforeseen emergency only). The Director/Principal shall not alter the award without the consent of the course teacher unless there are serious disciplinary charges. Any such action may be initiated only after receiving consent of the University. However, errant teachers shall be monitored and penalized by the Director/Principal.

(B) Practical Items

Every Item in this category shall be evaluated out of 100 percentage points, divided under two broad categories as detailed below:

a) End Semester examination: 60 percentage points

Operational Guidelines:

i. There shall be an End Semester Examination in each laboratory item, ordinarily with an external examiner present. The evaluation may be done based on:
   - Organization of the experiment
   - Actual data generated and the actual conduct of the experiment assigned.
   - Data analysis/Synthesis and Conclusions etc.
   - A comprehensive Viva - Voce seeking general awareness of the lab subject.

The relative emphasis shall be left to the external examiner & the Course teacher jointly.

ii. The award shall be finalized immediately by the Course teacher and the external examiner, if any, jointly and submitted in sealed cover to the University (COE's unit) along with all materials used by students during examination.

b) Laboratory Sessionals: 40 percentage points.

Operational Guidelines

i. The Course teacher shall be the sole authority for finalizing award under this item.
ii. He shall divide the points under the following guidelines:
   - Attendance and regularity 5 points
   - Preparedness for conduct of experiment 10 points

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- Initiative to learn and interact 10 points
- Presentation of lab report, its regularity in submission and content 15 points

iii. The Course teacher shall finalize, the award (out of 40 points) before the end - Semester examination and communicate the same under sealed cover to the University (COE's unit), with a sealed copy to the Director/ Principal of the Institution/ college for record only.

c) Sessional Items (Out of 100 percentage points)

Explanation & Operational Guidelines

Sessional items are those where, either the formal_institutional contact hours are not specified, (viz. Practical Training, Extra/Co curricular participation), or there are no formal end Semester examination of the written kind, (viz. Comprehensive Viva-Voce, Seminar, Industrial Visits,etc.). For all items under these categories, the evaluation shall be done internally through an Institutional/_Departmental Committee, appointed by the Departmental Head and duly endorsed by the Director/ Principal.

The norms for assessment for sessional items may vary from item to item. A broad guideline is suggested:

i. For items which are conducted outside the institutions viz. Practical Training, Co-curricular/Extra-curricular participation, Industrial Visits, etc. - assessment may be made on the basis of Item Supervisor's assessment, report submitted by the student, if any, participation & attendance, and Viva-Voce conducted by an Institutional/Departmental Committee, constituted by the department Head and duly ratified by the Director/Principal.

ii. Items conducted in the dept/institution/college viz. Seminar, Comprehensive Viva Voce shall be evaluated by a Teacher's Assessment Committee constituted by the Department and ratified by the Director/Principal, based on participation and attendance in the course, comprehension of other seminars by fellow students, presentation and content of seminar presented, capability to address to questions by participants.

The award list for this item shall be finalized by all the members of the Teachers' Assessment Committee before the starting of the end-semester theory/practical examinations and shall be communicated to the University (COE's unit) under sealed cover, with a sealed copy to the Director/Principal for record only.

iii. A student failing in a sessional item shall be required to repeat the semester as a regular student and shall not be eligible for carry-over promotion.

6. Declaration of result, promotions, and grading system:

6.1 In order to pass the B.Tech/B.Pharm/B.Arch/B.OPTM BHM programme course a candidate must obtain at least D grades in each of the Theory, practical and Sessional items and a DGPA of 6.0 Part 4, Chapter II, Section 5.2.

The promotional status shall be indicated on the even semester credit card/sheet as per details indicated in Part 2,Chapter I.

6.2:

i. A candidate shall be eligible for promotion to the next higher level if he has cleared ALL course items of earlier semesters individually.
ii. A student shall be eligible for promotion to the next higher level/year with backlogs provided such backlogs are to be cleared within the time limit specified for completion of the course, as prescribed under the First Regulation, WBUT.
iii. has been a bona fide Regular student/Ex-student at the present level and is duly registered as such in the University and Institution under permission of the Director/Principal concerned.
iv. has not been involved in breach of discipline or has not been time barred due to non-completion of the course within the time limit fixed for the purpose.
v. has not been temporarily suspended / suspended for a specified period by the University/institution and has not been denied the privileges of a Regular student / Ex-student at the time when admissions to higher levels is in progress.

Candidates debarred under stipulations 6.2.(ii) to 6.2 (vi)shall have to apply for permission for admission to the higher level and obtain the same from the director/principal of concerned institution before registration.

The university shall publish a list of all successful candidates of each of the semester examinations within a reasonable time (one month) from the date of the last examination.

6.3 Grading System:

A. The promotional status shall be published on the Even Semester Credit Card/sheet as per details indicated in Part 2, Chapter I

- Candidates will be eligible for promotion to the next semester without clearing all end semester theory courses of earlier semesters if,
- Candidate has minimum attendance percentage of 75% in the previous semester
- Candidates must have appeared for all internal examinations and has secured marks in Continuous Assessments, Sessional Examinations, Practical Examinations

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Candidates must have applied for appearing in the end semester examinations and have valid admit card in previous semester

Candidates failed to achieve the minimum benchmarks as mentioned in (a), (b), (c) for promotion will not be eligible for promotion to the next higher semester.

Candidates will appear in the end semester theory examinations as back log candidate in corresponding semester of subsequent academic year. Marks scored in Continuous Assessments, Sessional Examinations, Practical Examinations during attending regular semester with minimum qualifying attendance would be carried all through. Backlog candidates would be allowed to appear in the end semester examinations only to achieve qualifying marks of the paper concerned.

If any candidate fails to secure minimum qualifying marks (pass marks) in sessional or practical examinations would suffer year lag and they must continue the semester concerned afresh in the next academic year. However, there would be no separate qualifying/pass marks in the internal examination of 30 marks (CA 25 plus attendance 5 marks). The marks of a back log paper will be determined from the marks obtained in theory examination and marks of the continuous evaluation of the regular semester. No up-gradation of internal/continuous assessment marks would be allowed.

If any candidates fail to achieve any of the three conditions above (a, b & c) in any semester (say, 1st semester), they would not be allowed to continue their study in the next semester (i.e. 2nd semester) and they have to fulfil the academic regulations by enrolling them in the next academic year from the discontinued semester (i.e. 1st semester) and so on.

However, there would not be any limit of number of back papers to continue their study in subsequent semester as regular candidate.

B. Revised Criterion of DGPA to award degree as per clause 6.1 of first regulation:

A student be awarded with DGPA for completion of his respective course if he or she successfully completes all the Theory/Practical/Sessional paper in all the semester successfully. The criterion for obtaining DGPA 6.0 for B.Tech/B.Pharm / B.Optm / BHM courses and 5.4 for Non-AICTE courses has been relaxed. The criterion for minimum DGPA is discontinued from AY 2019-20. There would be no examination for up gradation of marks normally. However, a student may apply for up gradation for improvement of DGPA to attain minimum 6.0 as special cases.

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Massive Open Online Courses (MOOCs) scheme at MAKAUT, WB (Applicable from the session 2020-21)

All India Council for Technical Education (AICTE) has introduced Model Curriculum for Bachelor of Technology programme with 160 credits in the entire programme of 4 years, and additional 20 credits will be required to be achieved through Massive Open Online Courses (MOOCs) from different platform for the degree of Bachelor of Technology with Honours. These additional 20 credits will have to be acquired with online courses (MOOCs) as per AICTE. Students of B Tech program will have to complete additional 20 credits through MOOCs within 4 years of time. 16 credit points is applicable for 3 year UG programs. This creates an excellent opportunity for students to acquire the necessary additional skill set for employability through massive open online courses where the rare expertise of world famous experts from academics and industry are available. Maulana Abul Kalam Azad University of Technology, West Bengal (MAKAUT,WB) has thus decided to introduce AICTE model curriculum for its B.Tech Programmes and allow students to choose courses from any established online platform as per following revised guidelines from academic year 2020-21.

GUIDELINES FOR MOOCs

MOOCs (Massive Open Online Courses) have been inducted in University curriculum and academic activities in the following ways:

- MOOCs for Honors Degree at Undergraduate Level
- MOOCs for mandatory Coursework of Research Scholars for Ph.D. degree
- MOOCs are also used for credit transfer as equivalent to theory courses of Curriculum under recommendation of BoS.
- MOOCs for Mandatory Additional Requirements (MAR)

(A) MOOCs for B.Tech Honours Degree

For B.Tech Honors Degree, a B.Tech student will have to earn 20 credits from MOOCs fromany established MOOCs platform addition to 160 credits for B.Tech degree.

The total of 20 credits that is required to attain eligibility for B.Tech Honours degree is distributed over four years in the following way:

1st year: 4-8 credits

2ndyear: 4-8 credits

3rdyear: 4-8 credits

4thyear: 4 credits

A student of first year must cover courses from at least three skills:

1. Computer Programing with Python /R
2. Soft skills
3. values and Ethics

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Students of all streams are to be equipped with Programming skill in the language that is in high demand worldwide in the first year itself so that they can apply this skill in the subsequent semesters in their different areas including their core area of study.

Soft skill is very essential for grooming of the student and student must be exposed to it in the very beginning of the 4-year long program.

Ethics is something that one should practice. Students are to be made aware of the ethics right in the beginning of the 4-year long program so that they can practice at least some of the ethical norms as applicable to Institutional environment and society and be prepared to practice ethics in their working life.

All the MOOC's courses are to be taken any MOOCs platform as per following scheme of credit points. There would not be any concept of fixed basket anymore. However, during choosing courses in the online platform students would essentially avoid the courses taught/offered through the curriculum in the offline / classroom mode.

- For NPTEL/Swayam platform: Credit points as specified in the platform
- For other MOOCs platforms like Coursera, edX, Udemy, Simpilearn etc Courses of 4 weeks to 7 weeks: 1 credit point
- Courses of 8 weeks to 11 weeks: 2 credit point Courses of 12 weeks to 15 weeks: 3 credit point Courses of 16 weeks or more: 4 credit point
- Where duration of MOOCs courses is available in hours: For every 8 hours of course: 1 credit point

However, for the courses with duration less than 8 hours, multiple courses could be taken together (preferably in the same area) to consider 1 credit point. But where duration is available in week, count of hours will not be applicable.

The above structure is indicative only. And BoS/DC concerned may propose credit points of the courses offered through MOOCs platform based on the content and level beginner/ intermediate/ advanced) of the courses.

(B) MOOCs for Research Scholars for Ph.D. degree

Research scholars must take MOOCs as mandatory as a part of coursework for Ph.D. degree as per advice of the Research Supervisor. The credits for the course will be as per the assignment of credit for the course in the University website according to the length (in weeks) of the course, even if there is different credit assignment in the MOOCs platforms.

MOOCs for Credit Transfer

As per University guideline DSCSITSC had already introduced provision of credit transfer through MOOCs courses. Therefore, different courses of curriculum could be taken from MOOCs platform and credits could be transferred, if offered through online and credits are earned. However, to offer courses of curriculum through MOOCs platform like NETEL / SWAYAM / Coursera / edX / Simplilearn etc, offering institute must get the course mapping (Mapping between the University

course and that offered from the online platform) approved from the University for appropriate Credit Transfer Scheme.
If a student of the university is unable to attend a theory course due to attending internship or any other justified reason, the student may be allowed with special permission of the University to pursue equivalent MOOCs for against the theory course. However, content mapping to be completed preferably by BoS or appropriate authority is essential before opting the courses in MOOCs platform. More than one MOOCs courses may be necessary to be mapped to cover the syllabus of the theory course and the student has to complete all the MOOCs to cover the course. Credits earned in total in all the courses will be considered for equivalence and credit transfer.

Evaluation of the MOOCs course

Evaluation of the MOOCs courses would be done by the organization by whom it is being offered. In extraordinary circumstances, the modality of evaluation through certified personnel, online or offline, will be decided by the appropriate authority.

Uploading of MOOCs Data

As per University guideline DSCSITSC has to upload the details of MOOCs data in respect of each student time to time in University's examinations portal and/or hard/soft copy as per instruction of the Controller of Examinations of the University. This is applicable for University's In-House Programs also.

MOOCs for Mandatory Additional Requirements (MAR)

MOOCs in MAR is provided for encouraging every student to enter in Digital Content form of Education from well-known Universities or organizations.
Students can choose any MOOCs course as per their interest area. There is no credit system for MOOCs in MAR as points could be earned as specified in the scheme and the MOOCs courses which are taken for earning credits for Honours degree will not be considered in MAR purpose.
The validity of uploaded certificates in the University portal is subject to acceptance of appropriate committee/expert review.
Colleges interested to deliver any course(s) online through MOOCs platform, should get vetted from the University regarding mapping of course for credit transfer/assessment process.
This notification supersedes all earlier instructions regarding MOOCs courses.

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SurTech

MAR for earning AICTE/non-AICTE UG Degree

The MAR Activity Points to be earned for Mandatory Additional Requirements (MAR), for the final year students of the academic year 2018- 19 in AICTE and non-AICTE courses, a re-clarification is provided below:

Academic Year 2018-19	Activity Points
6th Semester (For all three-year courses)	25
8th Semester (For all four-year courses)	25
10th Semester (For five-year course)	25

A student should acquire a total of minimum 100 / 75 activity points throughout 4year / 3year curriculum which should be acquired by earning a minimum of 20 activity points and maximum of 30 activity points in each year of his/her study, which is necessary for uniform distribution of MAR activities throughout the entire period of the academic curriculum of the students.
MAR activities for the students admitted up to the session 2018-19 and for the new session starting from 2019-20, will be in accordance with the following table.

Level of Entry in B.Tech Course	Total duration for earning Points	Minimum Points to be earned
1st Year starting from the academic year 2019-20 onwards	1st to 4th Year	100
2nd Year starting from the academic year 2019-20 onwards (Lateral Entry)	2nd to 4th Year	75

Table – I

Every student, who is admitted to the 4 years B.Tech program prior to the academic year 2019-20, is required to earn minimum number of Activity Points as per Table II in addition to the required academic grades, for getting MAKAUT, WB's B.Tech degree.

Current Semester	Total Minimum Number of Activity Points to be earned During the full course
2nd	100
4th	75
6th	50

Table –II

The courses under MOOCs which have been already taken into consideration i.e., 20 credit courses for awarding B.Tech degree with Honours and 16 credit courses for non-AICTE courses are not to be considered again for awarding activity points for MAR.
In addition to the existing activity point allotment for 12 weeks and 8 weeks MOOCs courses of

short duration (4 weeks/2 weeks) can also be done. 10/5 activity points will be allotted, based on the short course duration of 4weeks/2 weeks respectively. The courses with duration ranging from 18-40 hours must also get proper weightage. (See the following table for details)

Weeks/Hours	Activity Points	Maximum Activity Points
12weeks/40hours	20	40
8weeks/30hours	16	
4weeks/20hours	10	
2weeks/10hours	5	

Table-III

- Any MOOCS already done or registered before the introduction of MAR system is not to be considered again for awarding activity points for MAR. Those courses should not be taken into consideration with retrospective effect.
- A student can also select MOOCs from the MOOCs basket/repository as designed by the University
- for earning activity points for MAR. But the same course cannot be counted for Honours. There should not be any overlapping of MOOCs with regard to MAR and Degree with Honours.
- If any student is unable to get certificate from MOOCs platform after auditing the course, the college
- will extend facility for awarding point after evaluation in consultation with the University.
- The activity points allotted per research publication (Vide Serial No.9 of Table-V) shall carry equal full weights among joint authors, if any, to encourage the students in research work.
- In addition to SWAYAM/NPTEL/Spoken Tutorial the names of all available MOOCS can be
- included. At present, SWAYAM/NPTEL/Spoken Tutorial have only been mentioned (Vide Serial No. 1 of Table V).
- In Serial No. 15 of Table-V, 'Student Chapter' should be read as 'Active Participation in Student
- Chapter', that is, whether the concerned student is an active member of the same.
- A student may earn activity point, being a member of other professional bodies and by participating as a resource person.
- A separate dedicated server is needed for huge data on students' evaluation on the part of the
- colleges. Digital versions of all certificates regarding MAR can be uploaded in the college.
- Every student should upload his/her MAR activity data/certificate in the social media, viz., Facebook/Instagram, which can be counted as part of the documentary evidence.
- Activities must be open-ended, that is, there can be many activities, other than the specified list by
- MAKAUT. College authorities may introduce new activities, with the prior approval of the University.
- The University has introduced new activities as part of MAR, which would encourage
- entrepreneurship ability of the students. Such activities are listed in the following table.

New MAR Activities (In addition to the existing list, Vide Serial No. 22, Table-V)

	Name of the Activity	Points	Maximum Points Allowed
	Self-Entrepreneurship Programme		
a)	To Organize Entrepreneurship Workshop and Programmes	10	20
b)	To take part in Entrepreneurship Workshop and get certificate	5	10
c)	Video Film-Making on Entrepreneurship	10	20
d)	Submit Business Plan on any Project	10	20
e)	To work for start-up/as entrepreneur	20	40

Table-IV

- There must be a Single Point of Contact (SPOC) in each college, who will keep correspondences with the University on MAR activities and his/her name is to be informed to the University. In addition, there should also be a nominated SPOC on behalf of the University for liaison with the colleges.
- Random sample visits and check-ups of individual institutes, as well as digital survey may be
- conducted from time to time to ensure proper implementation of MAR.
- The colleges should maintain MAR files for individual students, preferably in digital format, which can be inspected periodically by the University authorities.
- Different levels of activities in relief camps should carry different weightage for allotting activity
- points in MAR (Vide Serial No. 5 of Table-V).
- Institutions should not raise any subscription from the students in the name of MAR activities

Notes:

1) Every student shall participate in the co-curricular and extra-curricular activities and produce documentary proof to the designated Faculty Members appointed by the Head of the Department/Principal/Director in the respective college. Thereby the student should earn the required points before he/she appears for the Final Examinations.

2) A student's result of his/her Final Examinations will be withheld until he/she completes the minimum activity points by the end of his/her Degree Programme.

3) In every semester, every student is required to prepare a file containing documentary proofs of activities, done by him/her. This file will be duly verified, and activity points will be assigned by the teachers as appointed above, at the end of every semester.

4) Each institution will form a three members committee, the composition of which is to be notified to the University. The committee will finalize the activity points for each student before entering them into the Online Point Entry System (at the URL, as specified by the COE of the University).

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5) Every student has to earn at least 75, 100 or 125 activity points for 3-, 4- or 5-year courses respectively. The points earned by the students will be reflected in their mark sheets.

Table V provides a List of Activity Heads and Sub-Activity Heads along with their capping of the activity points that can be earned by the students during the entire course duration.

6)

Sl. No.	Name of the Activity	Points	Maximum Points Allowed
1.	MOOCs (SWAYAM, NPTEL, Spoken Tutorial, EdX, Coursera,etc.)	20 (per course)	40
2.	Tech Fest/Fest/Teachers' Day/Fresher's Welcome		
	a) Organizer	5	10
	b) Participant	3	6
3.	Rural Reporting	5	10
4.	Tree Plantation and up keeping (per tree)	1	10
5.	Participation in Relief Camps		
	a) Collection of funds/materials for the Relief Camp	5	40
	b) To be a part of the Relief Work team	20	
6.	Participation in Debate/Group Discussion/Tech Quiz/Quiz	10	20
7.	Publication of Wall Magazine in institutional level (magazine/article/internet)	10	20
8.	Publication in Newspaper, Magazine and Blogs	10	20
9.	Research Publication (per publication)	15	30
10.	Innovative Projects (other than course curriculum)	30	60
11.	Blood donation	8	16
	Blood donation camp organization	10	20
12.	Participation in Sports/Games		
	a) College level	5	10
	b) University level	10	20
	c) District level	12	24
	d) State level	15	30
	e) National/International Level	20	20
13.	Cultural Programme (Dance, Drama, Elocution, Music	10	2

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	etc.)		0
14.	Member of Professional Society	10	20
15.	Student Chapter	10	20
16.	Relevant Industry Visit & Report	10	20
17.	Activities in different Clubs (Photography Club, Cine Club,Gitisansad)	5	10
18.	Participation in Yoga Camp (Certificate to be submitted)	5	10
19.	Adventure Sports with Certification	10	20
20.	Training to under-privileged/differently able	15	30
21.	Community Service & Allied Activities	10	20
22.	Self-Entrepreneurship Programme		
	a) To Organize Entrepreneurship Workshop and Programmes	10	20
	b) To take part in Entrepreneurship Workshop and get certificate	5	10
	c) Video Film-Making on Entrepreneurship	10	20
	d) Submit Business Plan on any Project	10	20
	e) To work for start-up/as entrepreneur	20	40

Table V

College Code and Name:														**Course:**
Student Name:			**University Roll No:**											**Registration No:**
Total number of Semesters:					**Points Earned**									
Sl No.	**Activity**	**Points**	**Max. Points Allowed**	**Sem1**	**Sem2**	**Sem3**	**Sem4**	**Sem5**	**Sem6**	**Sem7**	**Sem8**	**Sem9**	**Sem10**	**Total**
1	***MOOCS (SWAYAM/NPTEL/Spoken Tutorial) per course***													
	For 12 weeks duration/40 Hours	**20**	**40**											
	For 8 weeks duration/30 Hours	**16**												
	For 4 weeks duration/20 Hours	**10**												
	For 2 weeks duration/10 Hours	**5**												
2	***Tech Fest/Fest/Teachers Day/Fresher's Welcome***													

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	Organizer	5	10											
	Participant	3	6											
3	Rural Reporting	5	10											
4	Tree Plantation and up keeping (per tree)	1	10											
5	Participation in Relief Camps													
	a) Collection of fund/ materials for the Relief Camp	5	40											
	b) To be a part of the Relief Work Team	20												
6	Participation in Debate/Group Discussion/ Tech quiz /Quiz	10	20											
7	*Publication of Wall magazine in institutional level (magazine/article/internet)*													
	Editor	10	20											
	Writer	6	12											
8	Publication in News Paper, Magazine & Blogs	10	20											
9	Research Publication (per publication)	15	30											
10	Innovative Projects (other than course curriculum)	30	60											
11	Blood donation	8	16											
	Blood donation camp Organization	10	20											
12	*Participation in Sports/Games*													
	a) College level	5	10											
	b) University Level	10	20											
	c) District Level	12	24											
	d) State Level	15	30											
	e) National/International Level	20	20											
13	Cultural Programme (Dance, Drama, Elocution, Musicetc.)	10	20											
14	Member of Professional Society	10	20											
15	Student Chapter	10	20											

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16	Relevant Industry Visit & Report	10	20											
17	Photography activities in different Club(Photography club, CineClub, Gitisansad)	5	10											
18	Participation in Yoga Camp (Certificate to be submitted)	5	10											
19	Community Service & Allied Activities	10	20											
20	Adventure Sports with Certification	10	20											
21	Training to under privileged / Differently Abled	15	30											
22	Self-Entrepreneurship Programme													
a)	To organise entrepreneurship programmes andworkshops	10	20											
b)	To take part in entrepreneurship workshop and getcertificate	5	10											
c)	Video film making on entrepreneurship	10	20											
d)	Submit business plan on any project	10	20											
e)	To work for start-up/as entrepreneur	20	40											
Total Points														
Signature of Mentor														
Signature of HOD														

*Please abide strictly to the Notes at the end of the Notice of MAKAUT,WB regarding Mandatory Additional Requirement for earning UG Degree

*Activity Points are to be uploaded in the given format in the specific MAR portal of the University, the link for which will be provided shortly.

*If any student performs activities outside the list enclosed, then he/she can do so with prior approval of the University.

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DR. SUDHIR CHANDRA SUR DEGREE ENGINEERING COLLEGE

540, Dum Dum Road, Surermath, Kolkata- 700074, West Bengal

Policy for Examination Reforms

(W.e.f 2018-19)

Approved by BOG
Dated on 03/07/2018
Under Agenda No. 3

Ref. No:	Compiled By:	Checked By:	Approved By:
DSDEC/POLY/2018-19/14			
Issue No-3	OIC, Exam Cell	(IQAC Convener)	(Principal)

OIC, Examination Cell MAKAUT Dr. Sudhir Chandra Sur Degree Engineering College (C.Code : 267) 540, Dum Dum Road, Kolkata-700 074

Coordinator, IQAC Dr. Sudhir Chandra Sur Degree Engineering College 540, Dum Dum Road, Kolkata -700074

Principal Dr. Sudhir Chandra Sur Degree Engineering College 540, Dum Dum Road, Surermath Kolkata - 74

Examination Reforms Policy

The globalization of the world economy and higher education is causing significant changes in engineering education. To guarantee that we remain competitive and can effectively respond to the difficulties of globalization, we must continue to dynamically adapt to these changes. Future engineering graduates will need a new set of soft, professional skills and abilities in addition to their technical expertise.

Engineering education has seen significant changes in recent years in terms of what to teach (topic), how to teach (knowledge delivery), and how to assess (student learning).

The AICTE has already begun the process of developing a model curriculum for engineering programmes. Through SWAYAM, the MHRD and AICTE's digital initiatives have made a huge number of MOOC courses online, which can assist colleges and teachers in adopting novel course delivery strategies.

Dr. Sudhir Chandra Sur Degree Engineering College (DSEC) has also taken the initiative to create our own Examination Reforms Policy based on the AICTE and MAKAUT guidelines.

In the light of the evolving landscape of engineering education, the current report focuses on proposals for modifications in examinations (student assessment).

Examinations/student assessments serve a critical role in determining educational quality. They must examine not simply the achievements (and grades) of students, but also whether the desired learning outcomes have been met. The accomplishment of goals and programme outcomes is critical, and it must be demonstrated through precise and trustworthy assessments.

For a long time, the academic quality of examinations (question papers) in the Indian engineering school system has been a source of worry. It is commonly accepted that "evaluation drives learning," and what and how students' study is heavily influenced by how they believe they will be evaluated. Simple memory recall will not assure deep, meaningful learning in question papers. High learning expectations encourage students to rise to the challenge. To guarantee that the learner is motivated to meet those high expectations, the assessment (examination) must implant them.

Exam reforms are necessary for improving the quality of Indian engineering education, given the imperatives. The following are the most major drivers for examination reform in Indian engineering education:

- **Adaptation of Outcome-Based Education Framework**

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In the worldwide engineering education situation, outcome-based education (OBE), a performance-based approach, has emerged as a prominent reform model. A country must implement OBE to become a signatory member of a global agreement for the mutual recognition of engineering degrees, such as the Washington Accord (WA). This will be an affirmation that the engineering education system has exhibited a strong, long-term commitment to quality assurance in generating engineers suited for international industry practice. The National Board of Accreditation (NBA), an Indian accreditation agency that is a signatory to the Washington Accord, has made it essential for engineering colleges to use the OBE framework for curriculum design, delivery, and assessment. The educational outcomes of a programme are clearly and unambiguously articulated in the OBE framework. The content and organization of the curriculum, as well as the teaching methods and strategies and the evaluation process, are all determined by these factors.

Though we are the Non-Autonomous Institute, we have begun to adopt the OBE framework for our engineering programmes, the focus has thus far been on the curriculum modification aspect, which involves tying curricular components to programme outcomes.

- **Importance of Higher-order Abilities and Professional Skills**

Memorization is the most important aspect of the current examination system. Although recall of factual knowledge is necessary for any examination, it is simply one of several major competencies that graduates must exhibit.

Higher-level skills, such as the capacity to apply knowledge, solve complicated issues, analyze, synthesize, and design, must also be tested during the assessment process.

Professional qualities such as communication, teamwork, and continual learning have also become crucial aspects for graduates' employability. It's critical that the examinations provide these higher-level talents and professional competences enough weight in the assessment.

Considering the above problems and a review of some of the world's best assessment techniques, the current policy offers various recommendations that our college has used to develop our assessment strategy.

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ASSESSMENT STRATEGY FOR OUTCOME-BASED EDUCATION

Mapping Program Outcomes to Assessment (Examinations)

Graduate attributes (GAs) define the general skills that a graduate of any undergraduate degree programme should possess. They combine to generate Program Outcomes (POs), which reflect graduates' skills, knowledge, and competencies regardless of subject of study. This is not to say that POs are unaffected by disciplinary knowledge; rather, these abilities can be acquired in a variety of academic settings.

A "design down" method is used in outcome-based education to move from POs to Course Outcomes (COs) to outcomes for individual learning experiences. Each successive level's outcomes must relate to and contribute to the program's goals.

A program's foundation is made up of courses. Teaching tactics, learning activities, assessments, and resources should all be developed and arranged to assist students in achieving course-level learning outcomes. Students demonstrate their degree of achievement of the course learning outcomes in the assessment tasks. The courses in a constructively aligned programme are meticulously organized to promote steady development or scaffolding from the introduction through mastery of the learning outcomes, ultimately leading to the attainment of the targeted POs. The achievement of POs is critical for the program's efficacy, which must be demonstrated by precise and trustworthy assessments.

Two-step Process for Bringing Clarity to POs

POs are beneficial for curriculum design, delivery, and assessment of student learning at the programme level. They are, however, generic high-level goals that are not directly measurable. At the course level, real observability and measurability of the POs is extremely challenging. There is a need to provide more clarity and specificity to the programme results to tie high-level learning outcomes (POs) with course content, course outcomes, and evaluation. This can be accomplished using the two-step approach of establishing Competencies and Performance Indicators outlined below (PI).

1) **Identify Competencies to be attained:** Define skills for each PO - varied abilities implied by the programme result statement that would necessitate distinct evaluation measures in most cases. This aids in the development of a common understanding of the competencies we want students to attain. They are used as a phase in the process of developing measurable indicators.
2) **Define Performance Indicators:** Define performance Indicators (PIs) for each of the selected

capabilities that are explicit assertions of student learning objectives. They can be used as measuring instruments in assessments to determine the extent to which outcomes have been achieved. They can also be constructed to determine the proper achievement level or competency of each indication, allowing teachers to set goals and students to reach a satisfactory level of proficiency.

It should be highlighted that, when considering the programme outcome, it appears that only the Capstone project will be able to achieve it. However, when we study the competences and performance indicators, we can see how these (and hence PO) can be addressed in various courses throughout the programme.

Once the program's assessment process is complete, the assessment of COs for all courses is created by connecting assessment questions (used in various assessment systems) to the PIs. We achieve clarity and better resolution for the assessment of COs and POs by following this method, where examination questions map to PIs. Figure 1 shows a visual representation of the procedure.

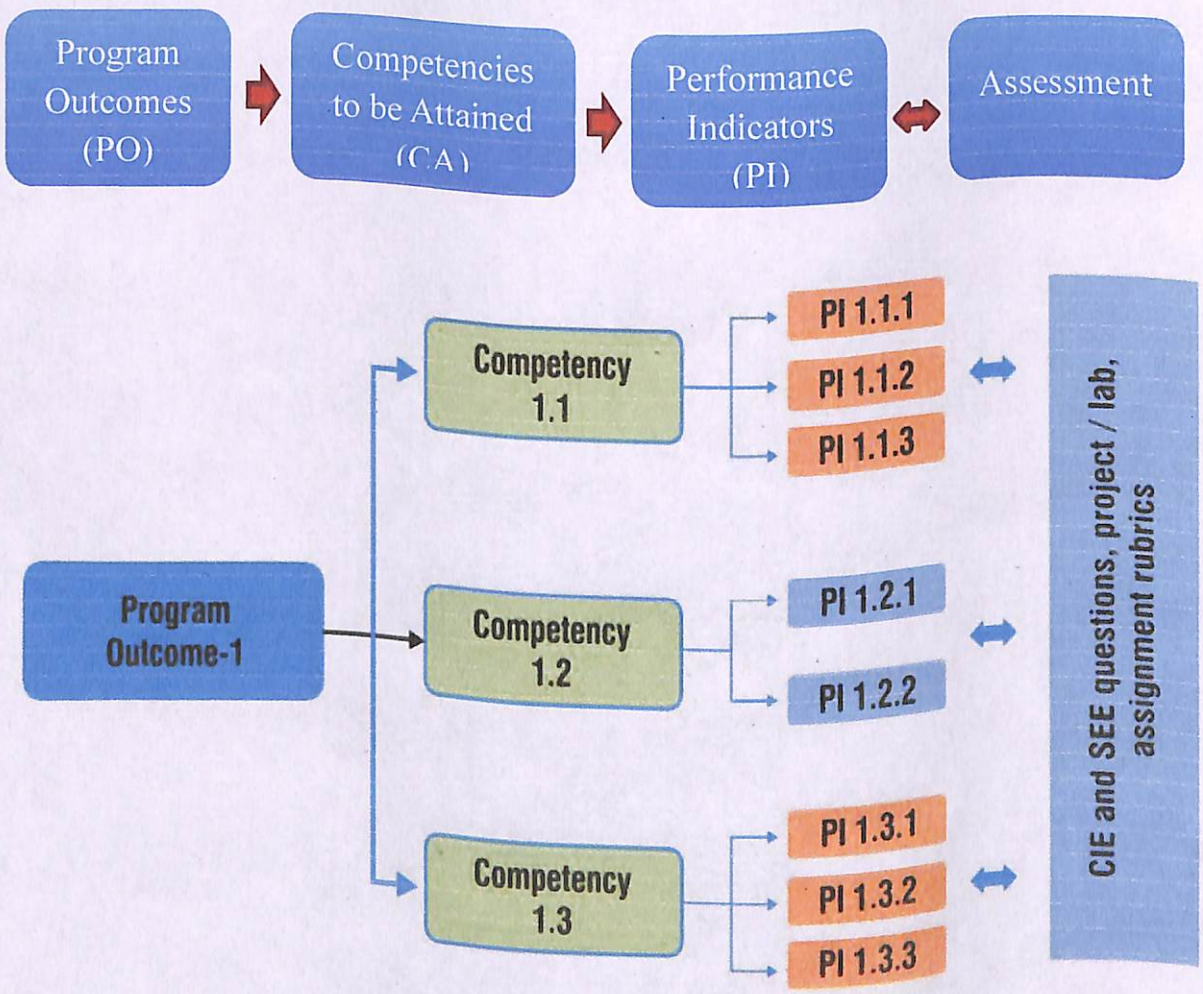

Figure. 1: Connecting POs to Assessment

Program Outcomes – Competencies – Performance Indicators

For each of the PO in Mechanical Engineering Program, the following table provides a suggested list of competences and associated performance metrics.

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 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 public health and safety, and cultural, societal, and environmental considerations.

Competency		Indicators	
3.1	Demonstrate an ability to define a complex/ open-ended problem in engineering terms	3.1.1	Recognize that need analysis is key to good problem definition
		3.1.2	Elicit and document, engineering requirements from stakeholders
		3.1.3	Synthesize engineering requirements from a review of the state-of-the-art
		3.1.4	Extract engineering requirements from relevant engineering Codes and Standards such as ASME, ASTM, BIS, ISO and ASHRAE.
		3.1.5	Explore and synthesize engineering requirements considering health, safety risks, environmental, cultural and societal issues
		3.1.6	Determine design objectives, functional requirements and arrive at specifications
3.2	Demonstrate an ability to generate a diverse set of alternative design solutions	3.2.1	Apply formal idea generation tools to develop multiple engineering design solutions
		3.2.2	Build models/prototypes to develop a diverse set of design solutions
		3.2.3	Identify suitable criteria for the evaluation of alternate design solutions
3.3	Demonstrate an ability to select an optimal design scheme for further development	3.3.1	Apply formal decision-making tools to select optimal engineering design solutions for further development
		3.3.2	Consult with domain experts and stakeholders to select candidate engineering design solution for further development
3.4	Demonstrate an ability to advance an engineering design to defined end state	3.4.1	Refine a conceptual design into a detailed design within the existing constraints (of the resources)
		3.4.2	Generate information through appropriate tests to improve or revise the design

PO 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.

Competency		Indicators	
4.1	Demonstrate an ability to conduct investigations of technical issues consistent with their level of knowledge and understanding	4.1.1	Define a problem, its scope and importance for purposes of investigation
		4.1.2	Examine the relevant methods, tools and techniques of experiment design, system calibration, data acquisition, analysis and presentation
		4.1.3	Apply appropriate instrumentation and/or software tools to make measurements of physical quantities
		4.1.4	Establish a relationship between measured data and underlying physical principles.
4.2	Demonstrate an ability to design experiments to solve open-ended problems	4.2.1	Design and develop an experimental approach, specify appropriate equipment and procedures
		4.2.2	Understand the importance of the statistical design of experiments and choose an appropriate experimental design plan based on the study objectives
4.3	Demonstrate an ability to analyze data and reach a valid conclusion	4.3.1	Use appropriate procedures, tools and techniques to conduct experiments and collect data
		4.3.2	Analyze data for trends and correlations, stating possible errors and limitations
		4.3.3	Represent data (in tabular and/or graphical forms) so as to facilitate analysis and explanation of the data, and drawing of conclusions
		4.3.4	Synthesize information and knowledge about the problem from the raw data to reach appropriate conclusions

PO 5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

	Competency		Indicators
5.1	Demonstrate an ability to identify/ create modern engineering tools, techniques and resources	5.1.1	Identify modern engineering tools such as computer-aided drafting, modeling and analysis; techniques and resources for engineering activities
		5.1.2	Create/adapt/modify/extend tools and techniques to solve engineering problems
5.2	Demonstrate an ability to select and apply discipline-specific tools, techniques and resources	5.2.1	Identify the strengths and limitations of tools for (i) acquiring information, (ii) modeling and simulating, (iii) monitoring system performance, and (iv) creating engineering designs.
		5.2.2	Demonstrate proficiency in using discipline-specific tools
5.3	Demonstrate an ability to evaluate the suitability and limitations of tools used to solve an engineering problem	5.3.1	Discuss limitations and validate tools, techniques and resources
		5.3.2	Verify the credibility of results from tool use with reference to the accuracy and limitations, and the assumptions inherent in their use.

PO 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.

	Competency		Indicators
6.1	Demonstrate an ability to describe engineering roles in a broader context, e.g. pertaining to the environment, health, safety, legal and public welfare	6.1.1	Identify and describe various engineering roles; particularly as pertains to protection of the public and public interest at the global, regional and local level
6.2	Demonstrate an understanding of professional engineering regulations, legislation and standards	6.2.1	Interpret legislation, regulations, codes, and standards relevant to your discipline and explain its contribution to the protection of the public

PO 7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and the need for sustainable development.

	Competency		Indicators
7.1	Demonstrate an understanding of the impact of engineering and industrial practices on social, environmental and in economic contexts	7.1.1	Identify risks/impacts in the life-cycle of an engineering product or activity
		7.1.2	Understand the relationship between the technical, socio-economic and environmental dimensions of sustainability
7.2	Demonstrate an ability to apply principles of sustainable design and development	7.2.1	Describe management techniques for sustainable development
		7.2.2	Apply principles of preventive engineering and sustainable development to an engineering activity or product relevant to the discipline

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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	Identify tenets of the ASME professional code of ethics
		8.2.2	Examine and apply moral & ethical principles to known case studies

PO 9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Competency		Indicators	
9.1	Demonstrate an ability to form a team and define a role for each member	9.1.1	Recognize a variety of working and learning preferences; appreciate the value of diversity on a team
		9.1.2	Implement the norms of practice (e.g. rules, roles, charters, agendas, etc.) of effective team work, to accomplish a goal.
9.2	Demonstrate effective individual and team operations--communication, problem-solving, conflict resolution and leadership skills	9.2.1	Demonstrate effective communication, problem-solving, conflict resolution and leadership skills
		9.2.2	Treat other team members respectfully
		9.2.3	Listen to other members
		9.2.4	Maintain composure in difficult situations
9.3	Demonstrate success in a team-based project	9.3.1	Present results as a team, with smooth integration of contributions from all individual efforts

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 11: **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's work, as a member and leader in a team, to manage projects and in multidisciplinary environments.		
	Competency	**Indicators**
11.1	Demonstrate an ability to evaluate the economic and financial performance of an engineering activity	11.1.1 Describe various economic and financial costs/benefits of an engineering activity 11.1.2 Analyze different forms of financial statements to evaluate the financial status of an engineering project
11.2	Demonstrate an ability to compare and contrast the costs/benefits of alternate proposals for an engineering activity	11.2.1 Analyze and select the most appropriate proposal based on economic and financial considerations.
11.3	Demonstrate an ability to plan/manage an engineering activity within time and budget constraints	11.3.1 Identify the tasks required to complete an engineering activity, and the resources required to complete the tasks. 11.3.2 Use project management tools to schedule an engineering project, so it is completed on time and on budget.

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 bellow:

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
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

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	2.5.1	Evaluate problem statements and identifies objectives
		2.5.2	Identify processes/modules/algorithms of a computer-based system and parameters to solve a problem
		2.5.3	Identify mathematical algorithmic knowledge that applies to a given problem
2.6	Demonstrate an ability to formulate a solution plan and methodology for an engineering problem	2.6.1	Reframe the computer-based system into interconnected subsystems
		2.6.2	Identify functionalities and computing resources.
		2.6.3	Identify existing solution/methods to solve the problem, including forming justified approximations and assumptions
		2.6.4	Compare and contrast alternative solution/methods to select the best methods
		2.6.5	Compare and contrast alternative solution processes to select the best process.
2.7	Demonstrate an ability to formulate and interpret a model	2.7.1	Able to apply computer engineering principles to formulate modules of a system with required applicability and performance.
		2.7.2	Identify design constraints for required performance criteria.
2.8	Demonstrate an ability to execute a solution process and analyze results	2.8.1	Applies engineering mathematics to implement the solution.
		2.8.2	Analyze and interpret the results using contemporary tools.
		2.8.3	Identify the limitations of the solution and sources/causes.
		2.8.4	Arrive at conclusions with respect to the objectives.

PO 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 public health and safety, and cultural, societal, and environmental considerations.

Competency		Indicators	
3.5	Demonstrate an ability to define a complex/ open-ended problem in engineering terms	3.5.1	Able to define a precise problem statement with objectives and scope.
		3.5.2	Able to identify and document system requirements from stake- holders.
		3.5.3	Able to review state-of-the-art literature to synthesize system requirements.
		3.5.4	Able to choose appropriate quality attributes as defined by ISO/IEC/IEEE standard.
		3.5.5	Explore and synthesize system requirements from larger social and professional concerns.
		3.5.6	Able to develop software requirement specifications (SRS).
3.6	Demonstrate an ability to generate a diverse set of alternative design solutions	3.6.1	Able to explore design alternatives.
		3.6.2	Able to produce a variety of potential design solutions suited to meet functional requirements.
		3.6.3	Identify suitable non-functional requirements for evaluation of alternate design solutions.
3.7	Demonstrate an ability to select optimal design scheme for further development	3.7.1	Able to perform systematic evaluation of the degree to which several design concepts meet the criteria.
		3.7.2	Consult with domain experts and stakeholders to select candidate engineering design solution for further development
3.8	Demonstrate an ability to advance an engineering design to defined end state	3.8.1	Able to refine architecture design into a detailed design within the existing constraints.
		3.8.2	Able to implement and integrate the modules.
		3.8.3	Able to verify the functionalities and validate the design.

PO 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.

Competency		Indicators	
4.4	Demonstrate an ability to conduct investigations of technical issues consistent with their level of knowledge and understanding	4.4.1	Define a problem for purposes of investigation, its scope and importance
		4.4.2	Able to choose appropriate procedure/algorithm, dataset and test cases.
		4.4.3	Able to choose appropriate hardware/software tools to conduct the experiment.
4.5	Demonstrate an ability to design experiments to solve open-ended problems	4.5.1	Design and develop appropriate procedures/methodologies based on the study objectives
4.6	Demonstrate an ability to analyze data and reach a valid conclusion	4.6.1	Use appropriate procedures, tools and techniques to collect and analyze data
		4.6.2	Critically analyze data for trends and correlations, stating possible errors and limitations
		4.6.3	Represent data (in tabular and/or graphical forms) so as to facilitate analysis and explanation of the data, and drawing of conclusions
		4.6.4	Synthesize information and knowledge about the problem from the raw data to reach appropriate conclusions

PO 5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Competency		Indicators	
5.4	Demonstrate an ability to identify/create modern engineering tools, techniques and resources	5.4.1	Identify modern engineering tools, techniques and resources for engineering activities
		5.4.2	Create/adapt/modify/extend tools and techniques to solve engineering problems
5.5	Demonstrate an ability to select and apply discipline-specific tools, techniques and resources	5.5.1	Identify the strengths and limitations of tools for (i) acquiring information, (ii) modeling and simulating, (iii) monitoring system performance, and (iv) creating engineering designs.
		5.5.2	Demonstrate proficiency in using discipline-specific tools
5.6	Demonstrate an ability to evaluate the suitability and limitations of tools used to solve an engineering problem	5.6.1	Discuss limitations and validate tools, techniques and resources
		5.6.2	Verify the credibility of results from tool use with reference to the accuracy and limitations, and the assumptions inherent in their use.

PO 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.

Competency		Indicators	
6.3	Demonstrate an ability to describe engineering roles in a broader context, e.g. pertaining to the environment, health, safety, legal and public welfare	6.3.1	Identify and describe various engineering roles; particularly as pertains to protection of the public and public interest at the global, regional and local level
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10.6	Demonstrate the ability to integrate different modes of communication	10.6.1 Create engineering-standard figures, reports and drawings to complement writing and presentations 10.6.2 Use a variety of media effectively to convey a message in a document or a presentation

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11.5 Demonstrate an ability to compare and contrast the costs/benefits of alternate proposals for an engineering activity	11.5.1 Analyze and select the most appropriate proposal based on economic and financial considerations.
11.6 Demonstrate an ability to plan/manage an engineering activity within time and budget constraints	11.6.1 Identify the tasks required to complete an engineering activity, and the resources required to complete the tasks. Use project management tools to schedule an engineering project, so it is completed on time and onbudget.

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
12.4 Demonstrate an ability to identify gaps in knowledge and a strategy to close these gaps	12.4.1 Describe the rationale for the requirement for continuing professional development 12.4.2 Identify deficiencies or gaps in knowledge and demonstrate an ability to source information to close this gap
12.5 Demonstrate an ability to identify changing trends in engineering knowledge and practice	12.5.1 Identify historic points of technological advance in engineering that required practitioners to seek education in order to stay current 12.5.2 Recognize the need and be able to clearly explain why it is vitally important to keep current regarding new developments in your field
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IMPROVING STRUCTURE AND QUALITY OF ASSESSMENTS / EVALUATION

Goals of Evaluation

- To clarify objectives of education
- To provide guidance & remedial work
- To identify the problems of students & their needs, levels and development
- To improve the skills of learning in students
- To bring improvements in instructional strategies & teaching-learning process
- To assess the educational value and utility of the educational programme
- To provide useful feedback
- To influence decision making or policy formulation by provision of empirically driven
- To assess personality of the pupils
- To analyze teacher student behavior
- To analyze effectiveness of A.V. aids

Defects in traditional evaluation system

- Assessment in not followed systematically as well as continually
- Competencies are not assessed through traditional system of evaluation.
- Assessment is too often carried out. One can't get a realistic picture of what students have mastered.
- After evaluation students are unable to apply what they have learnt through different concepts.
- Feedback provided is not at all formatives.
- Learning difficulties cannot be identified.
- The personal and social qualities are totally ignored Remedial instruction is not provided
- Instructional strategies cannot be assessed.

Needs of Reformation of traditional evaluation system

Education remains the primary engine of upward economic mobility. Due to the pioneering entrepreneurial efforts of a few in Bangalore and Hyderabad, India is today uniquely poised to become an intellectual powerhouse in the new 'knowledge' era.

Pharmaceutical and biotech research, consulting, and of course software development, all promise hundreds of thousands of high-paying and fulfilling jobs—if, however, the Indian education system can produce students with the required skill-sets and attitudes.

It would have to tap students in small towns and rural areas—not merely because a larger number of 'knowledge workers' will be needed than big cities could produce but because social justice demands that the rural and small-town population be given (howsoever belatedly) the opportunity to benefit from the newer engines of economic growth.

So, the Teaching-Learning Procedures & the Evaluation through the Test & Examination should be reformed.

The following points should be remembered to improve the structure and quality of evaluation in various engineering programmes:

- Written examinations play a significant role in assessing student learning and granting grades in the Indian engineering education system. In terms of total grading, the college places the greatest emphasis on the results of written examinations. The level of learning the student is expected to attain in the courses, and hence in the programme, is determined by the questions raised in the examination/test papers. Because evaluation motivates students to study, the design of question papers must go beyond a simple memory test. They must also put higher-order abilities and skills to the test.

- Written tests only examine a small number of outcomes and cognitive levels. Written tests alone will not be adequate to provide reliable judgments about student learning, particularly in courses where course outcomes (COs) cover a broad range of expectations. To ensure that assessment techniques fit learning outcomes, a variety of assessment methods (e.g., term papers, open-ended problem-solving assignments, course/lab project rubrics, portfolios, etc.) must be used.

- To create the evaluation plans for each of the program's courses to clarify the following:
  a. Alignment of assessment with course learning outcomes
  b. Learning level (cognitive) expected of students
  c. Assessment method to be adapted
- The mechanism for aligning examination questions/assessments to COs and thus POs using Bloom's taxonomy to design the best examination paper structure for testing various cognitive skills are addressed.

Bloom's Taxonomy for Assessment Design

Bloom's Taxonomy is a useful framework for developing not only curriculum and teaching methods, but also relevant examination questions for various cognitive levels.

Bloom's Taxonomy of Educational Objectives, created by Benjamin Bloom in 1956, is widely used by educators for curriculum development and assessment. Bloom's taxonomy was changed by Anderson and Krathwohl in 2001 to make it more relevant to today's needs. It tries to categories learning into three sorts of domains (cognitive, affective, and behavioral) and then assigns a level of performance to each. Conscious efforts to map the curriculum and assessment to these levels can aid programmes in aiming for higher-level abilities that need application, analysis, evaluation, or creation, rather than just remembering or understanding.

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 (Fig. 2) which are appropriate for the purposes of engineering educators.

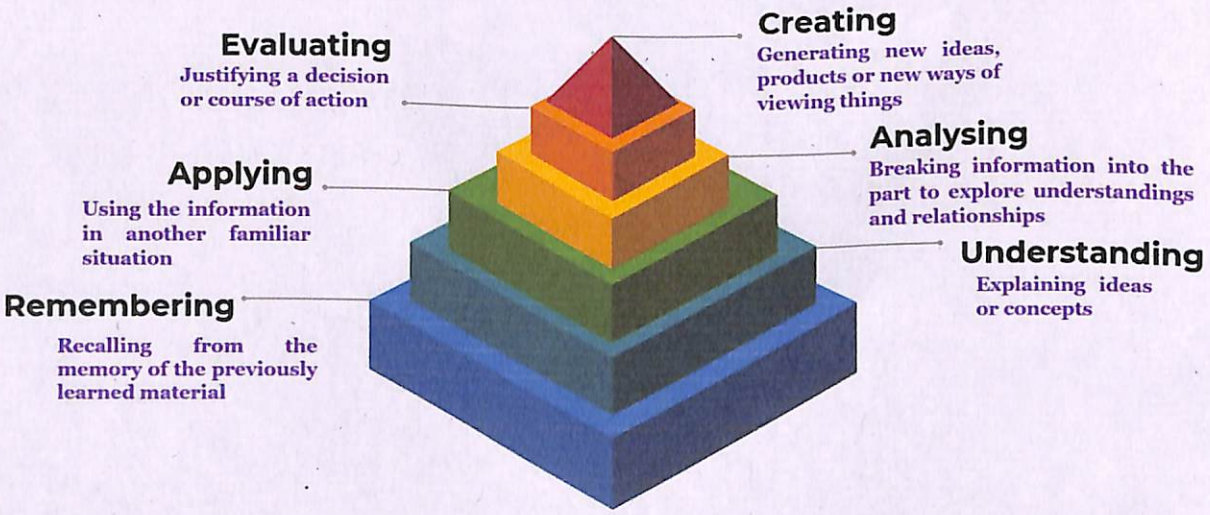

Fig. 2: Revised Bloom's Taxonomy

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
3	Applying	Using the information in another familiar situation
4	Analysing	Breaking information into the part to explore understandings and relationships
5	Evaluating	Justifying a decision or course of action
6	Creating	Generating new ideas, products or new ways of viewing things

Bloom's taxonomy is hierarchical, which means that learning at a higher level necessitates mastering skills at a lower one.

Suggestive list of skills/ competencies & Action Verbs for Assessment:

It's crucial to think about action verbs while creating evaluation questions. The action verbs are frequently indicative of the question's complexity (level). Educators have developed a taxonomy of quantifiable verbs that match to each of Bloom's cognitive levels across time. These verbs assist us in not just describing and categorizing observable knowledge, skills, and talents, but also in framing examination or assignment questions that are appropriate for the level we are attempting to assess.

Level	Skill Demonstrated	Question cues / Verbs for tests
1. Remember	• 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, tell, describe, recite, recall, identify, show, label, tabulate, quote, name, who, when, where
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
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

- **Types of Evaluation**

Examination

The term **examination** is strongly associated with **formal certification** for some purpose, be it in regular education or more general societal contexts.

Most of the times it results in some sort of **licence** to offer certain services and call oneself so or so (e.g. being a lawyer, being a physician, etc.), to use some device or practice some procedure (e.g. driver licence), or generally to ascertain publicly that one has got a certain skill or competence (e.g., a PhD).

Test

Tests are much more science-based, empirical, or technical, and have a much narrower scope than examinations.

Moreover, the terms 'test' and 'testing' are not only used for demonstrating specific **qualities of people** (as in intelligence test), but also of **material things or physical processes** (mainly in natural sciences and engineering).

The precise characteristics of tests and methodologies of testing are usually strictly rooted in relevant **empirical theories** and bound to explicit statistical or other mathematical **methods and techniques**.

Think e.g., of psychometric tests of competence or skills, audiometric tests (or hearing), material tests (e.g., stiffness, elasticity), etc.

Planning and designing of assessment of student learning using Bloom's Taxonomy

While using Bloom's taxonomy framework in planning and designing of assessment of student learning, following points need to be considered:

1. 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.

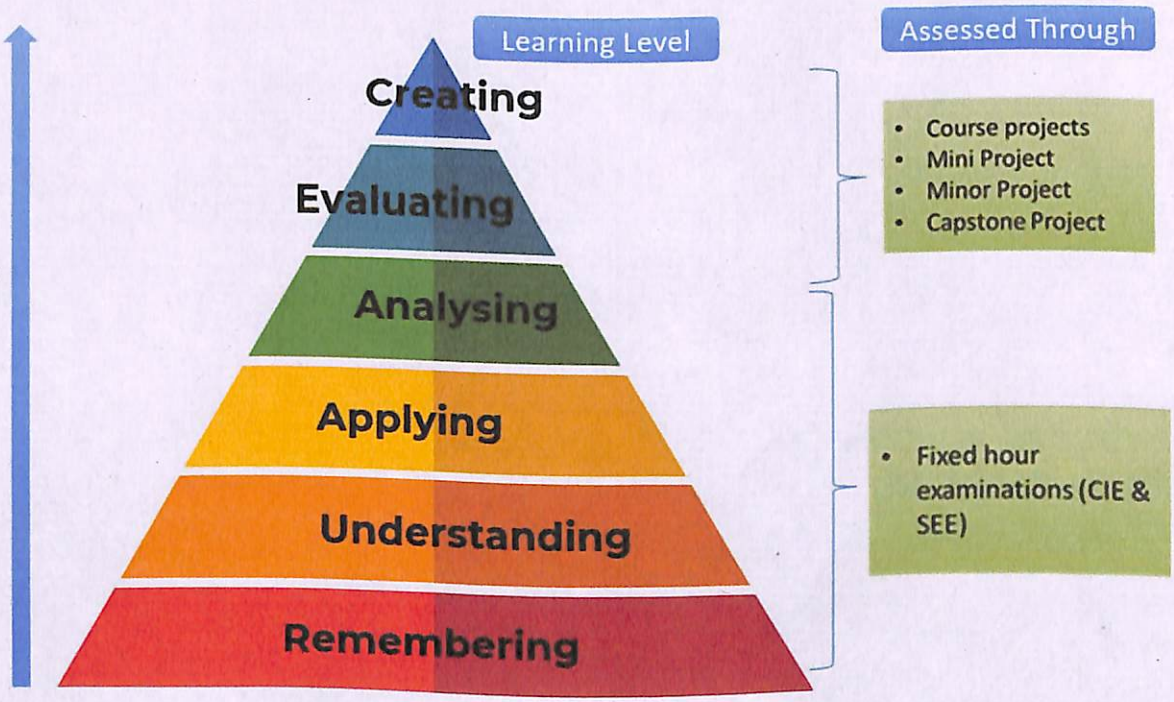

Fig. 3: Assessment methods for different Bloom's cognitive levels

2. Before adopting this framework for reforms in examination system of a University/Institution, it is worthwhile to study the present pattern of assessment in each of the course in the program to gain insight about:
   a) Alignment of assessment questions with course learning outcomes
   b) Whether all the learning outcomes are tested; sometimes some learning outcomes are over tested at the expense of others which may be not tested at all.
   c) Overall weightage in the assessment, to each of Bloom's learning levels
   d) Assessment methods used to adequately assess the content and desired learning outcomes

Based on the study, improvement priorities for each of the above factors need to be arrived

at. The reform process needs to be well planned and implemented through institutional strategy and communicated to all stakeholders particularly to the students.

3. A good and reasonable examination paper must consist of various difficulty levels to accommodate the different capabilities of students. Bloom's taxonomy framework helps the faculty to set examination papers that are well balanced, testing the different cognitive skills without a tilt towards a tough or easy paper perception. If the present examination questions are more focused towards lower cognitive skills, conscious efforts need to be made to bring in application skills or higher cognitive skills in the assessment. It is recommended that at institution/ University level, upper limit need to be arrived for lower order skills (for example, no more than 40% weightage for knowledge-oriented questions). It is important to note that, as nature of every course is different, the weightage for different cognitive levels in the question papers can also vary from course to course.

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 galvanization and tinning
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.
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. Summaries 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 " "?
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 nighttime 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.

2. 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.

3. A ladder 5.0 m long rests on a horizontal ground & leans against a smooth vertical wall at an angle 200 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.

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.

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. 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 analyze 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%.

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?

7. Albert is working on a 32-bit machine whereas Julie is working on a 64-bit machine. Both wrote the same code to find factorial of a number, but Albert is unable to find factorial of a number till 9 whereas Julie can find the factorial of higher number. Identify the possible reason why Albert is unable to find the factorial. Suggest some changes in the code so that Albert 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 is 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 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 must 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.

ASSESSING ABILITIES & PROFESSIONAL SKILLS OF STUDENTS

We can assess the students mainly in four modes: **Written Mode, Oral Mode, Practical Mode & Integrated Mode.**

Written Mode:
SE Exams
Class test
Self-test
Online test
Assignment
Report writing
Dissertations
Paper Review
Case Studies
Problem solving
MCQ
Open Book Test
Open Note Test
Essay writing
Annotated Bibliographies
Portfolios
MOOCs

Practical Mode:
Lab work
Comp. Sim. Work
Virtual Lab
Craft work
Co-Curriculars
Work experience

Oral Mode:
Viva /Oral Exam
One Question Quizzes
End of the Class Quiz
Think-Pair -Share
Group Discussion
Fishbowl technique
Role Play
Authentic Problem Solving
WSO (Watch Summaries Question)
Socratic Seminar
Grand Viva
Rapid Fire Questions
KWL (Know-Want To Know-Learned)

Integrated Mode:
Paper Presentations
Technical Seminar
SWOC Analysis
Authentic Problem Solving
Field assignments
Poster Presentation
Major & Minor Project
MOOCs
Portfolios

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ASSESSING HIGHER-ORDER ABILITIES & PROFESSIONAL SKILLS

Professional skills (also known as soft skills, generic skills, or transferable skills) have become crucial traits of a graduating engineer in the twenty-first century. Industry/employers around the world regard these qualities more than disciplinary knowledge, according to studies. Six of the twelve NBA graduate qualities, namely (1) communication, (2) teamwork, (3) understanding ethics and professionalism, (4) knowing global and societal settings, (5) lifelong learning, and (6) knowledge of contemporary challenges, fall into this category. Furthermore, higher-order cognitive qualities such as critical thinking, problem-solving, and making well-informed judgments are required for a graduate to succeed in the new environment. Despite the fact that businesses value these professional qualities and better talents, pupils are lacking in them. The fundamental issue with them is that they are difficult to assess using the current traditional test system.

Innovative Educational Experiences to Teach and Assess

One of the most significant barriers to addressing these outcomes is the educational experience we provide in our engineering programmes. Because most of our programme's coursework focuses on imparting technical information and skills, the assessment is restricted to those competencies. Obtaining professional outcomes, on the other hand, may not be the result of simply taking a class or a collection of classes. Rather, these outcomes are acquired or impacted by a variety of sources both inside and outside the classroom.

To overcome these issues, we need to make significant changes to the way we construct our curriculum, student learning experiences, and outcome evaluation. Several attempts are being made around the world to address these issues. The following are a few recommended educational experiences for teaching and assessing professional results and higher-order cognitive abilities:

- Course projects
- Open-ended experiments in laboratories
- Project-based learning modules
- MOOCs
- Co-Curricular experiences
- Mini / Minor projects
- Final year projects
- Internship experiences
- E-portfolios of student works

Using Scoring Rubrics as Assessment Tool

It is critical to have reliable techniques / suitable evaluation tools to evaluate the, as students attempt to achieve course goals and hence POs. Rubrics are an effective tool for evaluating and assessing student work. They can also act as a transparent and motivating learning guide. Rubrics are grading tools that are used to assess a student's performance and learning based on a set of

criteria and objectives. Rubrics communicate your assessment expectations to students (and other markers) as well as what you value.

Within rubrics, there are three components: I criteria/performance Indicator: (i) the aspects of performance that will be evaluated, (ii) descriptors: characteristics associated with each dimension, and (iii) scale/level of performance: a rating scale that defines students' level of mastery within each criterion.

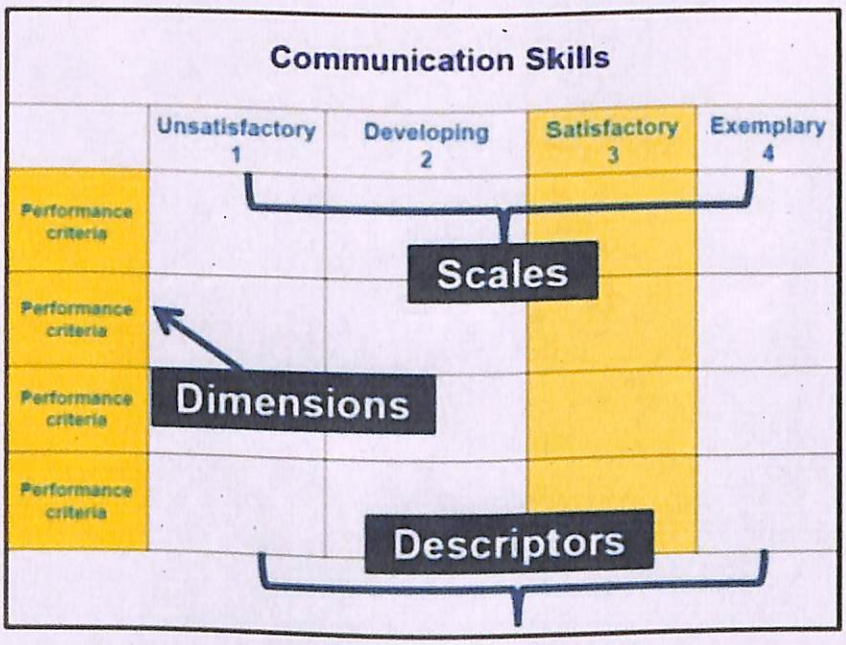

Fig. 4: Examples of Rubrics (Accessed from Rogers 2010)

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

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
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:				

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

MODEL QUESTION PAPER FOR END SEMESTER EXAMINATION

Course Name: Programming for Problem Solving
Duration: 3 hrs. ; Max. Marks: 100

Instructions:

a. Attempt five questions selecting ONE from each section. Question 9 (Section E) is compulsory.

b. All the questions carry equal marks.

c. Draw neat diagrams wherever applicable.

Q. No	Question	Marks	BL	CO	PO	PI Code
	Section-A					
1.	a. What is an algorithm? Explain the characteristics of an algorithm.	2+6	1,2	2	1	1.4.1
	b. Write an algorithm to find angle between hour and minute hands of a clock at a given time.	7	3	3	1	1.4.1
	c. Is it mandatory to declare main() function with return type as void or int. What will be the effect if there is no return type declared for main() function?	3+2	4	3	1	1.4.1
	OR					
2.	a. What is the difference between definition and declaration in C? When a user writes "int x;" is it treated as declaration or definition in C.	3+2	2,4	3	1	1.4.1
	b. Write a program in C to find largest of 3 positive integer numbers using conditional operators.	7	3	3	1,2	1.4.1, 2.2.4
	c. What is meant by iterative statements? What are the different types of iterative statements in C?	8	1,2	3	1	1.4.1
	Section-B					
3.	a. Bob has placed N objects in a row which are marked with a number equal to their weight in Kg. He wants to check whether the objects are in increasing order of their weights or not. Write a C program to help Bob.	12	3	3,6,7	1,2	1.4.1, 2.2.4
	b. Differentiate between Big-O and Big-Omega notation.	4	2	3	1	1.4.1
	c. What is the role of index in an array? How are the elements of a 2D array accessed in C?	2+2	2	3	1	1.4.1
	OR					
4.	a. Ram is conducting a study which is based on counting the number of cars crossing the highway. Every hour he generates a random string containing sequence of characters <rbwbwr...>, where r represents red color, w denotes white color and b denotes blue color cars. The string is forwarded to Shyam for analysis who computes the number of red, blue and white color cars crossing Ram every hour. Assume that Ram works for 5 hours in a day, help Shyam generate a daily report containing the following: i. Total number of different colour cars crossing Ram in an hour. ii. Total number of different colour cars crossing Ram in a day. iii. Total number of cars crossing Ram in a day.	4+4+4	3	3,6,7	1,2	1.4.1, 2.2.4

	b. What is a variable? Explain the ways to declare scope of a variable.	2+6	1,2	3	1	1.4.1
	Section-C					
5.	a. Write a program which will read positive integer numbers from the users and compute the sum if the number can be expressed as power of 2. The test whether a number can be expressed as power of 2 will be done using a function power_of_two(int a).	12	3	3,6,7	1,2	1.4.1
	b. What is recursion? Differentiate between homogeneous and heterogeneous recursion with the help of an example.	2+3+3	2	3	1	1.4.1
	OR					
6.	a. What are the different ways to pass parameters to a function? Explain with the help of a suitable example.	4+4	2	3,5	1	1.4.1
	b. Is it possible to return multiple values from a function? Justify the statement with the help of an example.	4+8	3	3,6,7	1,2	1.4.1
	Section-D					
7.	a. What is a structure? What is the benefit offered by using a structure over multiple arrays?	2+6	2	5	1	1.4.1
	b. Ram is working on a project which requires returning multiple values from a function. He observed that a return statement can only be used to return a single value from a function. How the function should be implemented so that multiple values can be returned by Ram?	12	4	5	1	1.4.1
	OR					
8.	a. Write a program that reads a number as input from the user. The entered number is written to a file "even.txt" if the input is even else it is written to "odd.txt". Write a C code to perform the desired task.	12	3	5	1	1.4.1
	b. What are the different methods to open a file? Explain each with the help of a C program.	3+5	2	5	1	1.4.1
	Section-E (Compulsory Question)					
9.	a. What is a compiler? List names of any 2 compilers.	2 ½	1	1	1	1.4.1
	b. What are the benefits of designing a flowchart for solving a problem?	2 ½	4	2	1	1.4.1

	c. What is the output of the following code?
	int main(){
	int x=10;
	int y=sizeof(x/2);
	printf("%d",y); }
		2 ½	3	4	1	1.4.1

	d. What is the difference between creating constant using #define macro and const keyword?	2 ½	3	3	1	1.4.1
	e. What is the role of function prototype? When is it required in C?	2 ½	2	3	1	1.4.1
	f. Which of the following are unary operators in C? State reason for your answer. a. ! b. sizeof c. ~ d. &&	2 ½	2	3	1	1.4.1

	g. Which of the following special symbol allowed in a variable name? State reason for your answer. a. * (asterisk) b. | (pipeline) c. - (hyphen) d. _ (underscore)	2 ½	2	3	1	1.4.1
	h. In which header file is the NULL macro defined? State reason for your answer. a. stdio.h b. stddef.h c. stdio.h and stddef.h d. math.h	2 ½	2	3	1	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

Modern methods of the CIE & SEE assessment in various programs in our College

01 Continuous Evaluation system

02 Open-ended problem-solving & assignments

03 Case Study

04 Term papers & Course Project Rubrics

05 Grand Viva & Oral Exam /Viva Voce

06 Written Examination

07 Quiz Contest & Debate Contest

08 MOOCs

09 Choice Based Credit System

10 Open Book Examination

11 MCQ based Examinations

12 Essay Writing Examinations

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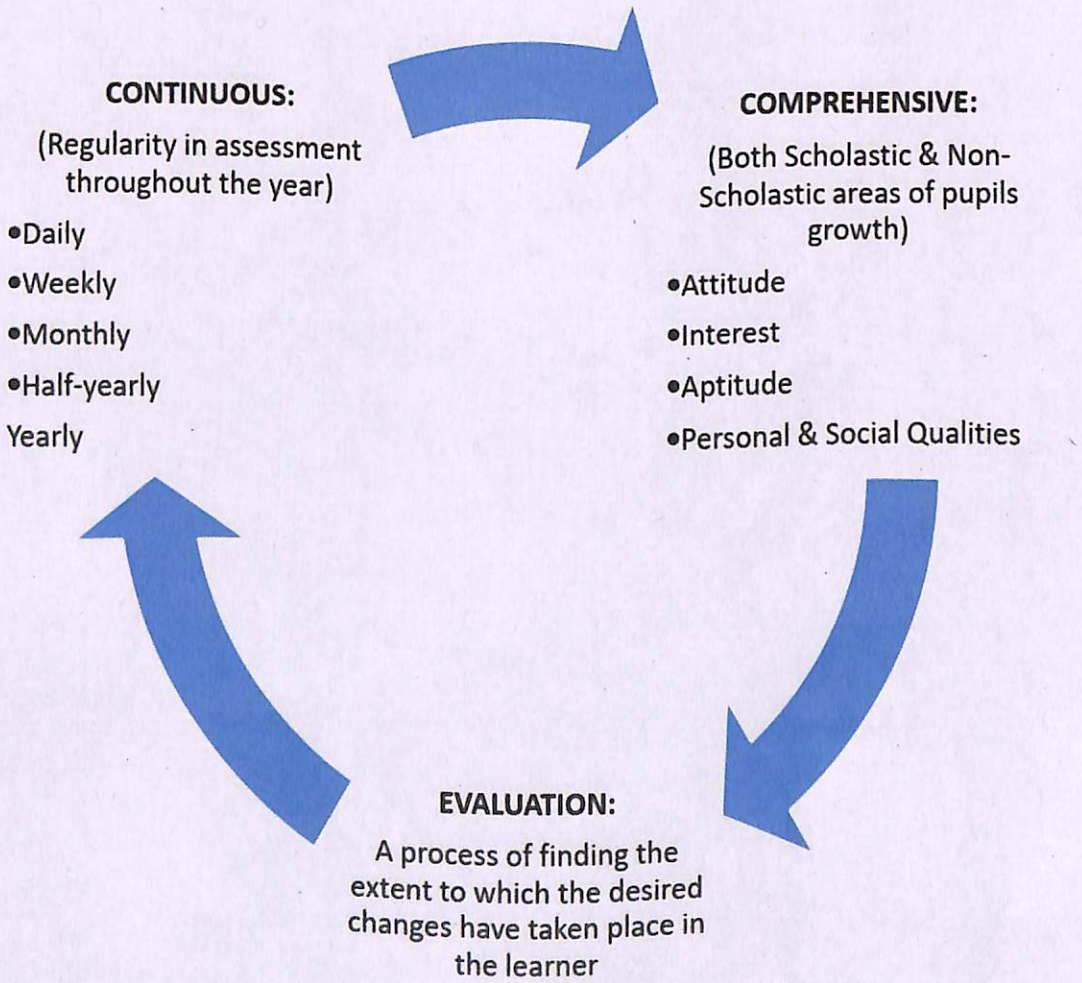
Continuous Evaluation System

Continuous and Comprehensive Evaluation (CCE) system is useful to assess all aspects of a student's development on a continuous basis throughout the year.

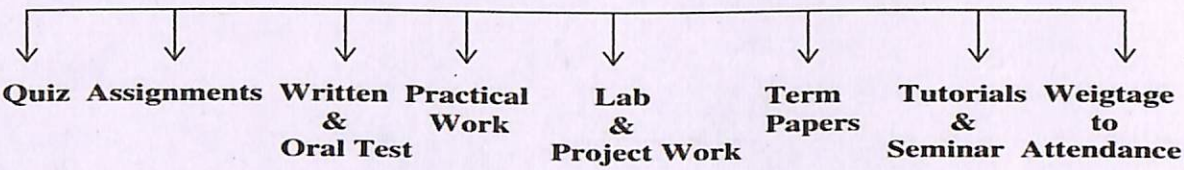
The assessment covers both scholastic subjects as well as coscholastic areas such as performance in sports, art, music, dance, drama, and other cultural activities and social qualities.

The main aim of CCE is to reduce pressure on students who are unable to effectively participate in the educational system and leave it dejected and with low self-confidence.

Students are required to participate in activities even if the syllabus is not covered.



Components of Continuous and Comprehensive Evaluation



Scholastic subjects are assessed using two modes: Formative Assessment (FA) and Summative Assessment (SA).

Formative evaluation helps in strengthening and improving the object being evaluated by examining the delivery of the program, the quality of its implementation, and the assessment of the context, procedures, inputs, etc.

Formative evaluation is conducted to monitor instructional processes to determine whether learning is taking place as planned.

It is concerned with judgments made during the testing or the development of a programme which is directed towards modifying, forming or improving the programme.

It considers smaller and independent units of the curriculum.

At the end of every unit, students should be given test for diagnosis.

These tests are used to make the process of teaching-learning highly effective.

It provides continuous feedback to both pupil and teacher concerning success and failure of the learning process.

Formative Assessment usually comprises of Class Tests, Homework, Quizzes, Projects, and Assignments directed throughout the year.

A summative evaluation examines the outcomes of the learners.

Summative evaluation is conducted at the end of the semester/ End of the Unit or Module after completion of the entire Unit/Module & Course.

It evaluates the achievements of education and is designed in such a way as to determine the extent to which the behavioral modification takes place in an individual.

Achievement tests and annual examinations are the various types of tests used in summative evaluation.

It is a later process that occur at the end of the academic session to measure the achievement of the pupils.

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Evaluation of Scholastic Areas:

	Term 1			Term 2		
	FA1	FA2	SA1	FA3	FA4	SA2
Weightage	10%	10%	30%	10%	10%	30%
Term Weightage	FA1+FA2+SA1=50%			FA3+FA4+SA2=50%		

Total: Formative Assessments (FA) = FA1+FA2+ FA3+FA4 = **40%**
Summative Assessments (SA) = SA1+SA2 = **60%**
Scholastic Assessment grades are generally given on a 9-point grading scale.

Evaluation of Co-Scholastic Areas:

Co-Scholastic areas are assessed using multiple techniques based on specific criteria.

Assessment of co-scholastic areas are done at the end of the year, and grades are generally given on a 5-point grading scale.

Minute Papers Examination

At the end of a class, instructors can ask students to write for a minute or two on one of the following kinds of questions:

"What is the most significant thing you've learned today?"

"What points are still not clear?"

"What question is uppermost in your mind at the end of today's class?"

Responses can help instructors evaluate how well students are learning the material.

Class Test

This type of test includes all types of questions-essays, short answer, objective, Design in test all levels of cognitive domain; Exam Blueprint be prepared to ensure inclusion of all types & levels of questions and proper sampling of content. Rubrics (with detailed indicators of level wise performance) & Model Answers for making essay type questions for minimizing subjectivity; Making Criteria made known to students; Teacher should provide written feedback selectively & discuss answers in the class; Only Role/Code numbers, not names be written to avoid bias in marking; display of model answer copies.

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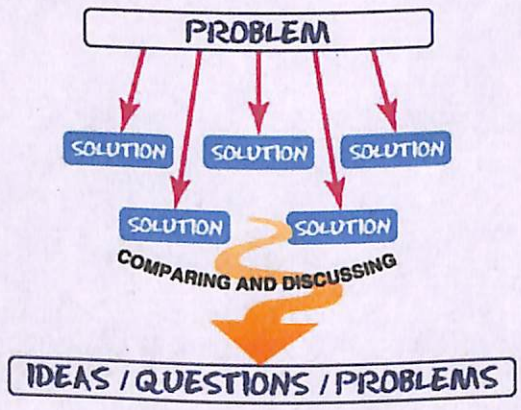
Open-ended problem-solving & assignments

Open-ended problem is a problem that has several or many correct answers, and several ways to the correct answer(s).

The Open-Ended Approach provides students with "experience in finding something new in the process"

Open-Ended problems are also used as assessment tasks because "In responding to such (open-ended) items, students are often asked not only to show their work, but also to explain how they got their answers or why they chose the method they did".

The Open-Ended Problem Solving also has been widely regarded as an advanced style of teaching mathematics in the U.S. & Japan recent years.



The assignments will be checked, and feedback will be given to the students, either by the instructor, or by a designated grader (usually a graduate student) - but under the instructor's close supervision.

The letter grade (from F=failed to A=very good) weighs the various numerical grades (how many correct solutions one gives).

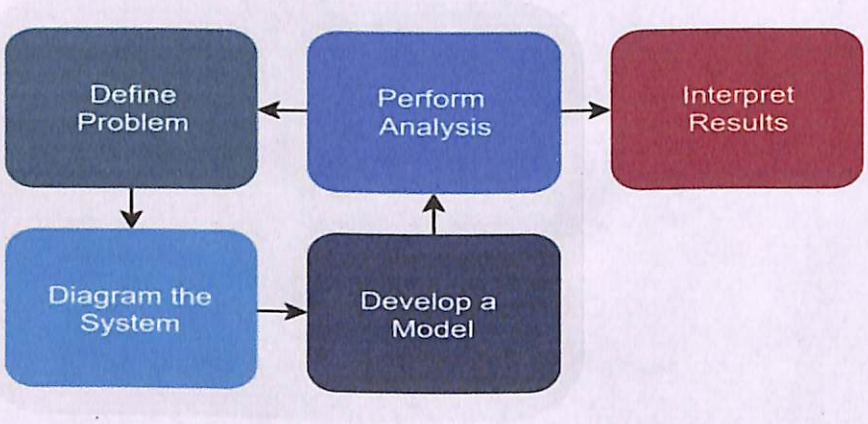
Case Study

A case study is an in-depth study of one person, group, or event.

In a case study, nearly every aspect of the subject's life and history is analyzed to seek patterns and causes of behavior.

Case studies can be used in a variety of fields including psychology, medicine, education, anthropology, political science, and social work.

Process diagrams for engineering case analysis



Case Study Evaluation Criteria

- User needs,
- Study design,
- Data characteristics and quality,
- Data management, and
- Institutional issues.

USER NEEDS

The term "user needs," refers to needs to find, evaluate, access, transfer, and/or combine data.

It also refers to requirements for manipulating, processing, analyzing, or otherwise working with the data.

Finally, it refers to the necessity for users to respond to institutional or cultural constraints, motivations, or pressures.

Identifying Users

- Was there a clear definition of users and user groups at the inception of the research project?
- Were users at each step of the data path, from initial data collection to final analysis and archiving, clearly defined?

Understanding Users' Requirements

- Were the specific requirements of users at each step of the data path clearly defined?
- Were future potential users' needs predicted and accommodated?
- Were there incompatibilities or conflicts among different user groups?
- Were institutional structures and management mechanisms (committees, working groups) established to identify users' needs and resolve conflicts?
- Did users feel as if their needs were accommodated? If not, why not?

Technical Aspects

- Did the study create specialized algorithms, routines, data management procedures, or database structures to accommodate users' needs? If so, how successful were they?
- Did the study, as originally envisioned, require interfacing disparate databases?
- Were interfacing requirements and issues understood and allowed for?

STUDY DESIGN

Conceptual Framework

- Was the study based on an overall conceptual model that described the relationships (both theoretical and functional) among different data types?
- Was the conceptual framework pursued to a level of detail that helped identify data interfacing issues?
- Was the conceptual framework explicitly multidisciplinary and multimedia?

Methodological Issues

- Was the study an interdisciplinary one involving multiple data types?
- Were all relevant disciplines and data types identified at the beginning of the study, or were midcourse adjustments required?
- Were pilot studies performed to assess potential data integration issues and solutions?
- Were data integration issues identified and planned for in the initial phase of the study? If not, at what stage of the study where they considered?

- Were methodological differences among study components that created difficulties in later integration identified at the outset of the study?
- What changes would the participants make in the study design if they had the opportunity to begin over again?

Data Integration

- Did the study design involve using preexisting data? If so, what problems were encountered? Were enough metadata available?
- Were there technical differences among disciplines that created data integration problems, e.g., requirements for different spatial scales or levels of detection?
- What kind of data integration did the study's data analyses require? Were these based on the study's underlying conceptual model and were they allowed for in the study design?

DATA CHARACTERISTICS AND DATA QUALITY

Data Characteristics

- Were data characteristics sufficiently documented in the metadata? If not, how difficult was it to find needed information about the data?

Quality Control

- If historical data were used, what quality control problems were encountered and how were they resolved?
- Were potentially problematic data characteristics known beforehand or discovered in the data integration process?
- How were differences in data quality among data sets handled?
- Were data quality procedures considered an integral part of data integration?
- How were data verified and validated?

Data Integration

- What specific data characteristics created data interfacing problems?
- What was the source(s) of these problems?
- Were there data formatting or quality standards that proved useful?

- What lessons were learned that would be applicable to other studies?

DATA MANAGEMENT

Data management refers to the provisions for handling the data at each step of the data path, from initial study design, through data collection, accessing, and analysis, to final reporting and archiving.

It refers not only to specific technical procedures, but also to the plan for ensuring the original quality of the data and preventing their degradation over time.

Data management plans should include organizational plans that specify data management functions and who has responsibility for data quality at each step of the data path.

Up-Front Planning

- Was there an overall data management plan that supported the data integration process?
- What provisions were made for data access, retrieval, and manipulation?
- Were data management procedures designed to relate directly to technical issues involved in data integration?
- Were quality control issues considered in all data management procedures?
- Were archival needs considered at the beginning of the study?

Data Management Procedures

- Were specific database tools developed to aid the database interfacing process?
- Are there readily identifiable authorized versions of the different data sets? If so, how are these maintained?
- What provisions were made to make metadata available to users?
- Did data management requirements related to database interfacing add to project overhead?
- Did data integration directly benefit project participants?
- How accessible were the data?
- Were there any restrictions on use of the data? If so, what was the source of these restrictions?

Planning for the Future

- Did data management procedures and systems explicitly consider future potential needs?
- What arrangements were made for archiving the data for future uses?
- Where are the data now and are they easily accessible? Are metadata readily available for future users?
- How easy would it be to transfer existing data to different database systems?
- What changes would the participants make in the data management plan if they had the opportunity to begin again?

INSTITUTIONAL ISSUES

Institutional issues often have an overriding influence on the success of data integration efforts, yet they can be difficult to identify and resolve.

These issues arise, for example, from differences in agency missions and mandates, from funding restrictions, from differences in time horizons and constituencies, and from differences in organizational cultures.

Participants

- Who were the key participants and what were their roles, responsibilities, and authority?
- What was the nature of the key participants, e.g., private, governmental?
- Were key players or data sources missing from the study?
- Did any participants place special conditions on their participation and/or on access to data, e.g., proprietary data?

Organization and Management

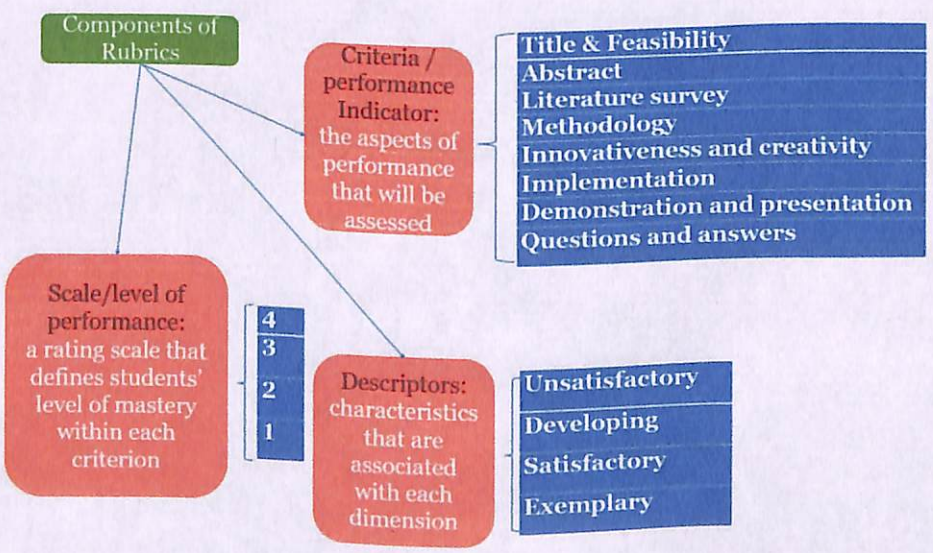
- What was the project's management structure, especially with regard to database interfacing? Was there a lead entity?
- Did the study's organizational structure support or impede database interfacing?
- What arrangements were made among the participants with regard to database interfacing? Were these formal or informal?
- What was the decision-making process, again especially with regard to database interfacing?
- What kinds of arrangements were made for acquiring data from other organizations?

- Was adequate funding available and committed for the duration of the study?
- Was there a long-term commitment to database updating and other maintenance?
- Who can access the data now and are there any restrictions on this
- What agency, if any, was given responsibility for long-term management and maintenance of the data?

Data Integration

- Did all participants agree with the need for data integration?
- What mechanisms were established for cooperation and data integration? Were any of these novel?
- Were potential conflicts and disagreements clearly identified and negotiated at the beginning of the study?
- Did agency missions, mandates, and policies restrict participation or otherwise impede database interfacing?
- Did existing data management practices impede data integration?

Term papers & Course Project Rubrics



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
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.

Using Scoring Rubrics as Assessment Tool

	Indicator	Inadequate(1)	Average(2)	Good(3)	Outstanding(4)	Mark selected	Weightage	Marks Obtained
Knowledge and Content	Organization of presentation	Hard to follow; sequence of information jumpy	Most of information presented in sequence	Information presented in logical sequence; easy to follow	Information presented as interesting story in logical, easy to follow sequence	4	3	
	Background content	Material not clearly related to topic OR background dominated seminar	Material sufficient for clear understanding but not clearly presented	Material sufficient for clear understanding AND effectively presented	Material sufficient for clear understanding AND exceptionally presented	4	3	
	Methods	Methods too brief or insufficient for adequate understanding OR too detailed	Sufficient for understanding but not clearly presented	Sufficient for understanding AND effectively presented	Sufficient for understanding AND exceptionally presented	4	3	
	Results (figures, graphs, tables, etc.)	Some figures hard to read Some in inappropriate format Some explanations lacking	Majority of figures clear Majority appropriately formatted Reasonably explained	Most figures clear Most appropriately formatted Well explained	All figures clear All appropriately formatted Exceptionally explained	4	3	
	Knowledge of subject	Does not have grasp of information; answered only rudimentary questions	At ease with information; answered most questions	At ease; answered all questions but failed to elaborate	Demonstrated full knowledge; answered all questions with elaboration	4	3	100
Presentation Skills	Graphics (use of Powerpoint)	Uses graphics that rarely support text and presentation	Uses graphics that relate to text and presentation	Uses graphics that explain text and presentation	Uses graphics that explain and reinforce text and presentation	4	2	
	Mechanics	Presentation has more than 10 misspellings and/or grammatical errors	Presentation has no more than 5 misspellings and/or grammatical errors	Presentation has no more than 2 misspellings and/or grammatical errors	Presentation has no misspellings or grammatical errors	4	2	
	Eye Contact	Reads most slides; no or just occasional eye contact.	Refers to slides to make points; occasional eye contact	Refers to slides to make points; eye contact majority of time	Refers to slides to make points; engaged with audience	4	2	
	Elocution - ability to speak English language	Mumbles and/or Incorrectly pronounces some terms Voice is low; difficult to hear	Incorrectly pronounces some terms Voice fluctuates from low to clear; difficult to hear at times	Incorrectly pronounces few terms Voice is clear with few fluctuations; audience can hear well most of the time	Correct, precise pronunciation of all terms Voice is clear and steady; audience can hear well at all times	4	2	
	Length and Pace	Short; less than 30 min Rushed OR dragging throughout.	Short 40 min OR long >50 Rushed OR dragging in part	Adequate 40-45 min Most of the seminar well paced.	Appropriate (45-50 min) Well-paced throughout	4	2	

PROJECT

RUBRICS FOR REVIEW – I

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%
2.1.1	Articulate problem statements and identify objectives - GA	02	Problem statement and objectives are not identified	Problem statement and objectives are not clear	Problem statement is clear and objectives are not in line with problem statement	Problem statement is clear and objectives are not completely defined.	Problem statement is clear and objectives are completely defined
2.1.2	Identify engineering systems, variables, and parameters to solve the problems - IA	02	Engineering systems are not identified. Variables, and parameters to solve the problems are not defined	Engineering systems are identified but not clear. Variables, and parameters to solve the problems are not defined	Engineering systems are clear. Variables, and parameters to solve the problems are not defined	Engineering systems are identified. Variables, and parameters to solve the problems are partially defined	Engineering systems are identified. Variables, and parameters to solve the problems are completely defined
2.2.3	Identify existing processes/ solution methods for solving the problem, including forming justified approximations and assumptions - GA	02	Not able to identify existing solution for solving the problem. The assumptions, approximations and justifications are also not identified.	Not able to identify existing solution for solving the problem. The assumptions, approximations and justifications are identified but not clear	Not able to identify existing solution for solving the problem. But assumptions and approximations are aligned to the objectives.	Able to identify existing solution for solving the problem. Assumptions, and approximations are clear	Able to identify existing solution for solving the problem. But assumptions, approximations and justifications are clear
2.2.4	Compare and contrast alternative solution processes to select the best process - GA	02	Not able to identify alternative solution processes	Not able to compare alternative solution processes	Able to compare alternative solution processes but could not contrast clearly	Able to compare alternative solution processes and contrast clearly but not able to select best process	Able to compare alternative solution processes, contrast it and also able to select best process
10.1.1	Read, understand and interpret technical and non-technical information - GA	02	Not able to identify technical and non-technical information	Able to identify non-technical information	Able to read technical and non-technical information, but could not understand and interpret	Able to read, understand technical and non-technical information, but could not interpret	Able to read, understand and interpret technical and non-technical information

GA – Group Assessment IA – Individual Assessment

RUBRICS FOR REVIEW – II

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%
3.2.1	Apply formal idea generation tools to develop multiple engineering design solutions - GA	02	Not able to identify tools to develop solutions	Able to identify but not able to use it effectively	Able to use the tool but not able to generate engineering designs	Able to generate engineering designs but not able to justify	Able to generate engineering designs with justification
3.2.3	Identify suitable criteria for evaluation of alternate design solutions - GA	02	Not able to identify criteria	Able to identify criteria but not able to use them	Able to use criteria but not able to compare alternatives	Not able to justify the comparison with criteria	Able to justify the comparison with criteria
3.3.1	Apply formal decision-making tools to select optimal engineering design solutions for further development - GA	02	Not able to identify decision-making tools	Able to identify but not able to choose optimum one	Able to identify optimum one but not able to use it	Able to use optimum one but not able to justify	Able to use optimum one with justification
3.2.2	Build models/ prototypes to develop diverse set of design solutions - IA	02	Not able to identify tool to build model/ prototype	Able to choose the tool but not able to use it effectively	Able to use the tool but not able to generate alternatives	Able to generate alternatives but not able to justify the best solution	Able to generate and justify the best solution
13.1.1	Develop 2D drawings of components/ systems using modern CAD tools - IA	02	Not able to identify CAD tools	Able to identify but not able to use CAD tool	Able to use CAD tool but not able to generate drawings	Able to generate drawings but not able to follow drawing standards	Able to generate drawings with standards
13.1.2	Develop 3D models of components/systems using modern CAD tools - IA	03	Not able to identify CAD tools	Able to identify but not able to use CAD tool	Able to use CAD tool but not able to generate 3D models	Able to generate models but not able to follow standards	Able to generate models with standards
13.1.3	Apply GD&T principles as per ASME standards to manufacturing drawings, with all relevant data like material, hardness, surface finish, and tolerances - IA	02	Not able to extract GD&T principles from ASME standards	Able to extract but not able to understand them	Able to understand but not able to apply GD&T standards	Able to apply GD&T standards to drawings but not able to justify	Able to apply and justify GD&T standards to drawings

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%
3.4.2	Generate information through appropriate tests to improve or revise design - GA	02	Not able to identify suitable tests to be done	Able to identify but not able to follow testing procedure	Able to follow testing procedures but not able to collect information	Able to collect information but not able to apply it for improvement	Able to apply information for the improvement
4.3.1	Use appropriate procedures, tools and techniques to conduct experiments and collect data - GA	04	Not able to identify tools, techniques and procedures	Able to identify but not able to conduct experiments	Able to conduct experiments but not able to follow procedure	Able to follow procedure but not able to collect data	Able to collect data as per the standards
4.3.2	Analyze data for trends and correlations, stating possible errors and limitations - GA	03	Not able to understand data	Able to understand but not able to analyze data	Able to analyze data but not able to correlate them	Able to correlate but not able to identify errors and limitations	Able to identify errors and limitations
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.

Grand Viva & Oral Exam /Viva Voce

Oral examination or viva-voce is used mainly to test the cognitive domain and is conducted with the aim of evaluating the qualities like depth of knowledge, ability to discuss and defend one's decision, attitudes, alertness, ability to perform under stress and professional competence.

The oral exam (also oral test or *viva voce*) is a practice in many schools and disciplines in which an examiner poses questions to the student in spoken form.

The student must answer the question in such a way as to demonstrate sufficient knowledge of the subject to pass the exam.

The oral exam also helps reduce (although it does not eliminate) the risk of granting a degree to a candidate who has had the thesis or dissertation by an expert.

The Conventional Viva-voce examination (CVE) is fraught with subjectivity and has been found to have poor validity, reliability, and objectivity.

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.
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.

A Structured Viva-voce Examination (SVE) using card system for the viva-voce was designed for the semester term ending examinations for students.

A. Subject/ Course Based card System

B. Module based Card System

C. Topic based Card System

Implementation Procedure:

1. Based on the syllabus and after due weightage to the various topics as per the curriculum prescribed by the Department, questions were framed under all modules.

2. The questions were developed with graded levels of difficulty for different topics of the examination.

3. The questions were subjected to peer review and finalized with approval of head of the department.

4. Cards were designed with questions written on them.

5.The students were briefed about the system prior to the examination and consent was obtained.

6.The viva was conducted by two faculty members. Each faculty dealt with five topics.

7.At the viva 10 sets for each Module of cards were laid out on the table. Each set had two subsets a) direct questions b) applied questions.

9.The student began from any of the major categories and randomly chose a fixed number of cards from each topic sequentially and attempted to answer the same.

10.Depending on the initial response of the student, he/she was encouraged to respond to questions of lower or higher level of difficulty as the case maybe to assess the level of student's knowledge.

Also, a mix of direct questions and applied questions from the two subsets was used.

Conventional Viva-voce Examination:

Sl	Statements
1	Examiners can be moody affecting performance
2	Examiners tend to skip some topics, hence incomplete
3	Tendency to be biased
4	Focus too much on one topic especially of their interest
5	Proceed haphazardly
6	Questions are predictable

Structured Viva-voce Examination:

1	Covers all topics, hence comprehensive evaluation
2	Eliminates subjective bias
3	Minimizes chances of repetitive questions for subsequent students
4	Helps to focus on one topic at a time
5	Students get more time to think
6	Helps student perform better
7	Is student friendly
8	Helps maintain chain of thought because of sequential questions

Written Examination

In Indian engineering education system, written examinations play a major role in assessing the learning and awarding of grades to the student

Universities and colleges give highest weightage to the outcomes of the written examinations in overall grading.

Questions raised in the examination/test papers play an important role in defining the level of learning the student is expected to achieve in the courses and hence in the program.

Since assessment drives learning, the design of question papers needs to go beyond the mere test of memory recall.

Written examinations assess a very limited range of outcomes and cognitive levels.

Particularly in the courses, where course outcomes (COs) cover a broad range of expectations, written examinations alone will not be sufficient to make valid judgements about student learning.

Quiz Contest & Debate Contest

This type of tests can be conducted 4 per semester including 1 Makeup & 1 Surprise Quiz; Also valuable as 'End of the class quiz'.

Teachers be trained in construction, advantages and precautions while preparing different types of objective items; Balance between recognition and recall types; Go beyond factual information to HOT skills.

Debate Contest: Levels of Performance for AFFIRMATIVE & NEGATIVE Team

Criteria	4	3	2	1	Grade:
Organization & Clarity: Main arguments and responses are outlined in a clear and orderly way.	Completely clear and orderly presentation	Mostly clear and orderly in all parts	Clear in some parts but not overall	Unclear and disorganized throughout	
Use of Argument: Reasons are given to support the resolution	Very strong and persuasive arguments given throughout	Many good arguments given, with only minor problems	Some decent arguments, but some significant problems	Few or no real arguments given, or all arguments given had significant problems	
Use of cross-examination and rebuttal: Identification of weakness in Negative team's arguments and ability to defend itself against attack.	Excellent cross-exam and defense against Negative team's objections	Good cross-exam and rebuttals, with only minor slip-ups	Decent cross-exam and/or rebuttals, but with some significant problems	Poor cross-exam or rebuttals, failure to point out problems in Negative team's position or failure to defend itself against attack.	
Presentation Style: Tone of voice, clarity of expression, precision of arguments all contribute to keeping audience's attention and persuading them of the team's case.	All style features were used convincingly	Most style features were used convincingly	Few style features were used convincingly	Very few style features were used, none of them convincingly	
					TOTAL SCORE:

MOOCs

MOOCs: Massive Open Online Courses (MOOCs) are such online courses which are developed as per the pedagogy stated herein and following the four-quadrant approach consisting of video , text, self-assessment and learn more.

There is two types of Courses: credit courses and non-credit courses.

Credit Course shall mean a course which is taught for at least one semester as a part of a PG Programme in Indian Universities.

Non-Credit Course shall include courses like awareness programme, continuing education programme or of specific skill set as independent course, which are not part of any set curriculum.

Subject: shall mean a specific area under a discipline (Example: Physics) taught in an educational institution consisting of specific programme/ courses, resulting in the award of a certificate/ diploma/ degree shorter duration.

After clearing the Online Course by a Student of an University/ Institute, then the University/ Institute should issue certificate(s) and 'Transfer the Credits' to registered Students under SWAYAM that are existing as regular & enrolled students from a recognized University/Institute across the country and shall follow, the UGC (Credit Framework for Online Learning Courses through SWAYAM) Regulation, 2016, a 'Gazette Notification' issued on 19th July, 2016.

Credit Allocation:

A 1 to 3 credit SWAYAM course is expected to be covered in 4-12 weeks' duration including the assessment component in which (it should be 40 hours (for 3 credit course) to 80 hours (for a 6-credit course) of learning from e- Content, reading reference material, discussion forum posting and assignment.

For other MooC Courses, One credit will be equivalent to 10 hours of learning including participating in discussion forums and other interactions, working on assignments and activities designated for the course etc.

Choice Based Credit System

Majority of Indian higher education institutions have been following marks or percentage-based evaluation system, which obstructs the flexibility for the students to study the subjects/courses of their choice and their mobility to different institutions.

There is need to allow the flexibility in education system, so that students depending upon their interests and aims can choose interdisciplinary, intra-disciplinary and skill-based courses.

This can only be possible when choice-based credit system (CBCS), an internationally acknowledged system, is adopted.

The choice-based credit system not only offers opportunities and avenues to learn core subjects but also exploring additional avenues of learning beyond the core subjects for holistic development of an individual.

To bring uniformity in evaluation system and computation of the Cumulative Grade Point Average (CGPA) based on student's performance in examinations, the UGC has formulated the guidelines to be followed:

Outline of Choice Based Credit System:

Core Course: A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.

Elective Course: Generally, a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/ subject of study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill is called an Elective Course.

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Discipline Specific Elective (DSE) Course: Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective.

The University/Institute may also offer discipline related Elective courses of interdisciplinary nature (to be offered by main discipline/subject of study).

Dissertation/Project: An elective course designed to acquire special/advanced knowledge, such as supplement study/support study to a project work, and a candidate studies such a course on his own with an advisory support by a teacher/faculty member is called dissertation/project.

Generic Elective (GE) Course: An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective.

A core course offered in a discipline/subject may be treated as an elective by other discipline/subject and vice versa and such electives may also be referred to as Generic Elective.

Ability Enhancement Courses (AEC): The Ability Enhancement (AE) Courses may be of two kinds: Ability Enhancement Compulsory Courses (AECC) and Skill Enhancement Courses (SEC).

"AECC" courses are the courses based upon the content that leads to Knowledge enhancement; i. Environmental Science and ii. English / MIL Communication.

These are mandatory for all disciplines.

SEC courses are value-based and/or skill- based and are aimed at providing hands on-training, competencies, skills, etc.

Ability Enhancement Compulsory Courses (AECC): Environmental Science, English Communication/MIL Communication.

Skill Enhancement Courses (SEC): These courses may be chosen from a pool of courses designed to provide value-based and/or skill-based knowledge.

Introducing Research Component in Under-Graduate Courses Project work/Dissertation is considered as a special course involving application of knowledge in solving / analyzing /exploring a real-life situation / difficult problem. A Project/Dissertation work would be of 6 credits. A Project/Dissertation work may be given in lieu of a discipline specific elective paper.

Open-Book Examinations

The traditional written examinations have a significant weakness that they tend to encourage rote learning and more superficial application of knowledge.

This deficiency can be overcome by "open-book examination".

Open-book examination is like time constrained written examinations but designed in a way that allows students to refer to either class notes, textbooks, or other approved material while answering questions.

They are particularly useful if you want to test skills in application, analysis and evaluation, i.e. higher levels of Bloom's taxonomy.

However, in a program, the courses or the curriculum areas that are best suited to an open-book exam are to be carefully chosen.

Designing a good open-book examination

Set questions that require students to do things with the information available to them, rather than to merely locate the correct information and then summarize or rewrite it.

The questions in open-book exam must take advantage of the format, and give more weightage to the application of knowledge, critical thinking and use of resources for solving real complex engineering problems.

As the nature of questions is complex, it is to be ensured that the students get enough time.

Open book test questions typically take longer time compared to traditional examinations.

It is advisable either to set a smaller number of questions that encompass 2 or 3 concepts taught or allocate longer duration of time for the examinations.

Open Note Exams

Note making techniques be taught to students, Not just direct questions from notes, but application analysis and synthesis of that knowledge. One of the class tests or some class assignments could be of this type.

MCQ based Examinations

In a test that has items formatted as multiple-choice questions, a candidate would be given several set answers for each question, and the candidate must choose which answer or group of answers is correct.

There are two families of multiple-choice questions.

The first family is known as the True/False question, and it requires a test taker to choose all answers that are appropriate.

The second family is known as One-Best-Answer question, and it requires a test taker to answer only one from a list of answers.

There are several reasons to using multiple-choice questions in tests.

In terms of administration, multiple-choice questions usually require less time for test takers to answer, are easy to score and grade, provide greater coverage of material, allows for a wide range of difficulty, and can easily diagnose a test taker's difficulty with certain concepts.

As an educational tool, multiple-choice items test many levels of learning as well as a test taker's ability to integrate information, and it provides feedback to the test taker about why distractors were wrong and why correct answers were right.

Nevertheless, there are **difficulties** associated with the use of multiple-choice questions.

In administrative terms, multiple-choice items that are effective usually take a great time to construct.

As an educational tool, multiple-choice items do not allow test takers to demonstrate knowledge beyond the choices provided and may even encourage guessing or approximation due to the presence of at least one correct answer.

Moreover, test takers may misinterpret these items and, in the process, perceive these items to be tricky or picky.

Finally, multiple-choice items do not test a test taker's attitudes towards learning because correct responses can be easily faked.

Essay Writing Examinations

Items such as essay typically require a test taker to write a response to fulfill the requirements of the item.

In administrative terms, essay items take less time to construct.

As an assessment tool, essay items can test complex learning objectives as well as processes used to answer the question.

The items can also provide a more realistic and generalizable task for test.

Finally, these items make it difficult for test takers to guess the correct answers and require test takers to demonstrate their writing skills as well as correct spelling and grammar.

The difficulties with essay items are primarily administrative: for example, test takers require adequate time to be able to compose their answers.

When these questions are answered, the answers themselves are usually poorly written because test takers may not have time to organize and proofread their answers.

In turn, it takes more time to score or grade these items.

When these items are being scored or graded, the grading process itself becomes subjective as non-test related information may influence the process.

Thus, considerable effort is required to minimize the subjectivity of the grading process.

Finally, as an assessment tool, essay questions may potentially be unreliable in assessing the entire content of a subject matter.

Instructions to exam takers rely on the use of **command words** which direct the examinee to respond in a particular way, for example by describing or defining a concept, comparing two or more scenarios or events.

Annotated Bibliographic

It is a good test of students' abilities to scan and evaluate literature; Can stimulate higher order thinking skills as students review; stimulates group work and discussion; Good preparatory skill for research. The topics should be based on students' interests and course requirements; referencing skills be first taught to students.

Group tasks

Assessment types includes Group discussion, Flash bowl Technique, Role Play, Authentic Problem Solving.
Small group of 2-5 members work on a joint task.
Suggested frequency of this test is once every semester with one makes up and one term-end in certain courses.
Groups formed must be roughly equivalent; Problems assigned should be equivalent; Each team member must have a specific role; Rubrics for marking must be mutually decided including all domains of education.

Rapid fire questions

Questions on a topic asked very quickly and answered very fast.
It may be embedded in classroom teaching as required.
Student should be told the criteria of a good question; May be assessed by two evaluators for greater objectivity; May be recorded for closer assessment.

Field Assignments

It includes field / industry visit with report. Conducts once in a Semester.
Students must be exposed to note taking and report writing skills, if visiting different sites reports may be presented in class for sharing of experiences & learning.

Rules & Regulations of Examination guided by MAKAUT

4. Rules for examinations

4.1 Each discipline of the B.Tech / B.Pharm / B.Arch / B.Optm programme consists of the following three types of items:

- Theory items
- Practical items
- Sessional items

The schedule of these items along with their credit points for each semester shall be as point 5.

4.2 At the end of each semester, there shall be an examination (here-in-after called end-semester examination) conducted by the University as per programme announced by the Controller of Examinations.

4.3 Back paper examinations, if any, shall be held with the normal end-semester examination.

4.4 There shall be no separate supplementary examination under normal condition for I/II/III year B.Tech/B.Pharm students (I/II/III/IV year B.Arch students). For the purpose of degree only supplementary examination for both 7^{th} and 8^{th} semester (9^{th} and 10^{th} semesters for B.Arch programme) shall be held within one month of the publication of final semester examination results.

5. Evaluation of course items

The evaluation of course items listed in para 4.1 shall be done as per the following guidelines:

(A) Theory Items

Each item under this classification shall be evaluated on the basis of 100 percentage points, sub-divided into the following four categories:

a) End-Semester examination: 70 points

Operational Guidelines:

i. A group of examiners drawn from the affiliated, institutions/colleges shall be appointed by the University for each theory subject.

ii. A 'Subject Examination Committee' consisting of an Expert Member from outside the affiliated institutions/colleges, a senior faculty from an affiliated institution and a faculty conducting the course shall be constituted by the University for each theory subject and duly ratified by the Advisory Committee/Academic Council. The Subject Examination Committee shall ensure uniformity in grading through spot/random checking, especially for candidates with very high grades/very low grades.

iii. The University shall follow a centralized evaluation system.

iv. Correction/Evaluation of scripts shall be completed, and award list submitted within a reasonable time after the completion of the examination as decided by the University.

v. The entire evaluation work shall be completed within a reasonable time after the completion of the examination as decided by the University.

b) Course tests/class tests: 15 points

Operational Guidelines:

i. Three tests shall ordinarily be conducted, as far as possible, at near-identical intervals by the course teacher. The best two performances shall only be considered for final reckoning.

ii. The Director/Head of the Department shall ordinarily set the test schedule and announce test dates as per University calendar.

iii. Test scripts shall be corrected/evaluated within seven days of actual conduct of test and the solutions discussed in the class. During- the discussions the students shall have access to the corrected scripts. The final award list for each test shall be put on the notice board within the next two days and copies communicated to the Director/Principal for record.

iv. The process shall be repeated for each test.

c) Quizzes and Assignments: 10 points

Operational Guidelines:

At least 3 to 4 unannounced quizzes shall be conducted by the course teacher during the lecture/tutorial class and suitable number of home assignments shall be insisted upon. The course teacher shall be solely responsible for final award under this category.

d) Attendance regularity and participation: 5 points

Operational Guidelines:

The award under this category shall be the sole prerogative of the Course teacher. Whereas attendance/regularity in a class is factual, assessment about participation is subjective. The idea is

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to encourage teacher/student interaction in Conduct of Courses and discourage one-way communication.

The Course teacher shall finalise the award of a student (out of 30, comprising b), c) and d) and communicate the award list to the University (Controller of Examinations' unit) under sealed cover, with a scaled copy to the Director/Principal of the Institute for records and reference under unforeseen emergency only). The Director/Principal shall not alter the award without the consent of the course teacher unless there are serious disciplinary charges. Any such action may be initiated only after receiving consent of the University. However, errant teachers shall be monitored and penalized by the Director/Principal.

(B) Practical Items

Every Item in this category shall be evaluated out of 100 percentage points, divided under two broad categories as detailed below:

a) End Semester examination: 60 percentage points

Operational Guidelines:

i. There shall be an End Semester Examination in each laboratory item, ordinarily with an external examiner present. The evaluation may be done based on:
   - Organization of the experiment
   - Actual data generated and the actual conduct of the experiment assigned.
   - Data analysis/Synthesis and Conclusions etc.
   - A comprehensive Viva - Voce seeking general awareness of the lab subject.

The relative emphasis shall be left to the external examiner & the Course teacher jointly.

ii. The award shall be finalized immediately by the Course teacher and the external examiner, if any, jointly and submitted in sealed cover to the University (COE's unit) along with all materials used by students during examination.

b) Laboratory Sessionals: 40 percentage points.

Operational Guidelines

i. The Course teacher shall be the sole authority for finalizing award under this item.
ii. He shall divide the points under the following guidelines:
   - Attendance and regularity 5 points
   - Preparedness for conduct of experiment 10 points

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- Initiative to learn and interact 10 points
- Presentation of lab report, its regularity in submission and content 15 points

iii. The Course teacher shall finalize, the award (out of 40 points) before the end - Semester examination and communicate the same under sealed cover to the University (COE's unit), with a sealed copy to the Director/ Principal of the Institution/ college for record only.

c) Sessional Items (Out of 100 percentage points)

Explanation & Operational Guidelines

Sessional items are those where, either the formal institutional contact hours are not specified, (viz. Practical Training, Extra/Co curricular participation), or there are no formal end Semester examination of the written kind, (viz. Comprehensive Viva-Voce, Seminar, Industrial Visits,etc.). For all items under these categories, the evaluation shall be done internally through an Institutional/_Departmental Committee, appointed by the Departmental Head and duly endorsed by the Director/ Principal.

The norms for assessment for sessional items may vary from item to item. A broad guideline is suggested:

i. For items which are conducted outside the institutions viz. Practical Training, Co-curricular/Extra-curricular participation, Industrial Visits, etc. - assessment may be made on the basis of Item Supervisor's assessment, report submitted by the student, if any, participation & attendance, and Viva-Voce conducted by an Institutional/Departmental Committee, constituted by the department Head and duly ratified by the Director/Principal.

ii. Items conducted in the dept/institution/college viz. Seminar, Comprehensive Viva Voce shall be evaluated by a Teacher's Assessment Committee constituted by the Department and ratified by the Director/Principal, based on participation and attendance in the course, comprehension of other seminars by fellow students, presentation and content of seminar presented, capability to address to questions by participants.

The award list for this item shall be finalized by all the members of the Teachers' Assessment Committee before the starting of the end-semester theory/practical examinations and shall be communicated to the University (COE's unit) under sealed cover, with a sealed copy to the Director/Principal for record only.

iii. A student failing in a sessional item shall be required to repeat the semester as a regular student and shall not be eligible for carry-over promotion.

6. Declaration of result, promotions, and grading system:

6.1 In order to pass the B.Tech/B.Pharm/B.Arch/B.OPTM BHM programme course a candidate must obtain at least D grades in each of the Theory, practical and Sessional items and a DGPA of 6.0 Part 4, Chapter II, Section 5.2.

The promotional status shall be indicated on the even semester credit card/sheet as per details indicated in Part 2,Chapter I.

6.2:

i. A candidate shall be eligible for promotion to the next higher level if he has cleared ALL course items of earlier semesters individually.
ii. A student shall be eligible for promotion to the next higher level/year with backlogs provided such backlogs are to be cleared within the time limit specified for completion of the course, as prescribed under the First Regulation, WBUT.
iii. has been a bona fide Regular student/Ex-student at the present level and is duly registered as such in the University and Institution under permission of the Director/Principal concerned.
iv. has not been involved in breach of discipline or has not been time barred due to non-completion of the course within the time limit fixed for the purpose.
v. has not been temporarily suspended / suspended for a specified period by the University/institution and has not been denied the privileges of a Regular student / Ex-student at the time when admissions to higher levels is in progress.

Candidates debarred under stipulations 6.2.(ii) to 6.2 (vi)shall have to apply for permission for admission to the higher level and obtain the same from the director/principal of concerned institution before registration.

The university shall publish a list of all successful candidates of each of the semester examinations within a reasonable time (one month) from the date of the last examination.

6.3 Grading System:

A. The promotional status shall be published on the Even Semester Credit Card/sheet as per details indicated in Part 2, Chapter I

- Candidates will be eligible for promotion to the next semester without clearing all end semester theory courses of earlier semesters if,
- Candidate has minimum attendance percentage of 75% in the previous semester
- Candidates must have appeared for all internal examinations and has secured marks in Continuous Assessments, Sessional Examinations, Practical Examinations

Candidates must have applied for appearing in the end semester examinations and have valid admit card in previous semester

Candidates failed to achieve the minimum benchmarks as mentioned in (a), (b), (c) for promotion will not be eligible for promotion to the next higher semester.

Candidates will appear in the end semester theory examinations as back log candidate in corresponding semester of subsequent academic year. Marks scored in Continuous Assessments, Sessional Examinations, Practical Examinations during attending regular semester with minimum qualifying attendance would be carried all through. Backlog candidates would be allowed to appear in the end semester examinations only to achieve qualifying marks of the paper concerned.

If any candidate fails to secure minimum qualifying marks (pass marks) in sessional or practical examinations would suffer year lag and they must continue the semester concerned afresh in the next academic year. However, there would be no separate qualifying/pass marks in the internal examination of 30 marks (CA 25 plus attendance 5 marks). The marks of a back log paper will be determined from the marks obtained in theory examination and marks of the continuous evaluation of the regular semester. No up-gradation of internal/continuous assessment marks would be allowed.

If any candidates fail to achieve any of the three conditions above (a, b & c) in any semester (say, 1st semester), they would not be allowed to continue their study in the next semester (i.e. 2nd semester) and they have to fulfil the academic regulations by enrolling them in the next academic year from the discontinued semester (i.e. 1st semester) and so on.

However, there would not be any limit of number of back papers to continue their study in subsequent semester as regular candidate.

B. Revised Criterion of DGPA to award degree as per clause 6.1 of first regulation:

A student be awarded with DGPA for completion of his respective course if he or she successfully completes all the Theory/Practical/Sessional paper in all the semester successfully. The criterion for obtaining DGPA 6.0 for B.Tech/B.Pharm / B.Optm / BHM courses and 5.4 for Non-AICTE courses has been relaxed. The criterion for minimum DGPA is discontinued from AY 2019-20. There would be no examination for up gradation of marks normally. However, a student may apply for up gradation for improvement of DGPA to attain minimum 6.0 as special cases.

Massive Open Online Courses (MOOCs) scheme at MAKAUT, WB (Applicable from the session 2020-21)

All India Council for Technical Education (AICTE) has introduced Model Curriculum for Bachelor of Technology programme with 160 credits in the entire programme of 4 years, and additional 20 credits will be required to be achieved through Massive Open Online Courses (MOOCs) from different platform for the degree of Bachelor of Technology with Honours. These additional 20 credits will have to be acquired with online courses (MOOCs) as per AICTE. Students of B Tech program will have to complete additional 20 credits through MOOCs within 4 years of time. 16 credit points is applicable for 3 year UG programs. This creates an excellent opportunity for students to acquire the necessary additional skill set for employability through massive open online courses where the rare expertise of world famous experts from academics and industry are available. Maulana Abul Kalam Azad University of Technology, West Bengal (MAKAUT,WB) has thus decided to introduce AICTE model curriculum for its B.Tech Programmes and allow students to choose courses from any established online platform as per following revised guidelines from academic year 2020-21.

GUIDELINES FOR MOOCs

MOOCs (Massive Open Online Courses) have been inducted in University curriculum and academic activities in the following ways:

- MOOCs for Honors Degree at Undergraduate Level
- MOOCs for mandatory Coursework of Research Scholars for Ph.D. degree
- MOOCs are also used for credit transfer as equivalent to theory courses of Curriculum under recommendation of BoS.
- MOOCs for Mandatory Additional Requirements (MAR)

(A) MOOCs for B.Tech Honours Degree

For B.Tech Honors Degree, a B.Tech student will have to earn 20 credits from MOOCs fromany established MOOCs platform addition to 160 credits for B.Tech degree.

The total of 20 credits that is required to attain eligibility for B.Tech Honours degree is distributed over four years in the following way:

1st year: 4-8 credits

2nd year: 4-8 credits

3rd year: 4-8 credits

4th year: 4 credits

A student of first year must cover courses from at least three skills:

1. Computer Programing with Python /R
2. Soft skills
3. values and Ethics

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Students of all streams are to be equipped with Programming skill in the language that is in high demand worldwide in the first year itself so that they can apply this skill in the subsequent semesters in their different areas including their core area of study.

Soft skill is very essential for grooming of the student and student must be exposed to it in the very beginning of the 4-year long program.

Ethics is something that one should practice. Students are to be made aware of the ethics right in the beginning of the 4-year long program so that they can practice at least some of the ethical norms as applicable to Institutional environment and society and be prepared to practice ethics in their working life.

All the MOOC's courses are to be taken any MOOCs platform as per following scheme of credit points. There would not be any concept of fixed basket anymore. However, during choosing courses in the online platform students would essentially avoid the courses taught/offered through the curriculum in the offline / classroom mode.

- For NPTEL/Swayam platform: Credit points as specified in the platform
- For other MOOCs platforms like Coursera, edX, Udemy, Simpilearn etc Courses of 4 weeks to 7 weeks: 1 credit point
- Courses of 8 weeks to 11 weeks: 2 credit point Courses of 12 weeks to 15 weeks: 3 credit point Courses of 16 weeks or more: 4 credit point
- Where duration of MOOCs courses is available in hours: For every 8 hours of course: 1 credit point

However, for the courses with duration less than 8 hours, multiple courses could be taken together (preferably in the same area) to consider 1 credit point. But where duration is available in week, count of hours will not be applicable.

The above structure is indicative only. And BoS/DC concerned may propose credit points of the courses offered through MOOCs platform based on the content and level beginner/ intermediate/ advanced) of the courses.

(B) MOOCs for Research Scholars for Ph.D. degree

Research scholars must take MOOCs as mandatory as a part of coursework for Ph.D. degree as per advice of the Research Supervisor. The credits for the course will be as per the assignment of credit for the course in the University website according to the length (in weeks) of the course, even if there is different credit assignment in the MOOCs platforms.

MOOCs for Credit Transfer

As per University guideline DSEC had already introduced provision of credit transfer through MOOCs courses. Therefore, different courses of curriculum could be taken from MOOCs platform and credits could be transferred, if offered through online and credits are earned. However, to offer courses of curriculum through MOOCs platform like NETEL / SWAYAM / Coursera / edX / Simplilearn etc, offering institute must get the course mapping (Mapping between the University

course and that offered from the online platform) approved from the University for appropriate Credit Transfer Scheme.
If a student of the university is unable to attend a theory course due to attending internship or any other justified reason, the student may be allowed with special permission of the University to pursue equivalent MOOCs for against the theory course. However, content mapping to be completed preferably by BoS or appropriate authority is essential before opting the courses in MOOCs platform. More than one MOOCs courses may be necessary to be mapped to cover the syllabus of the theory course and the student has to complete all the MOOCs to cover the course. Credits earned in total in all the courses will be considered for equivalence and credit transfer.

Evaluation of the MOOCs course

Evaluation of the MOOCs courses would be done by the organization by whom it is being offered. In extraordinary circumstances, the modality of evaluation through certified personnel, online or offline, will be decided by the appropriate authority.

Uploading of MOOCs Data

As per University guideline DSEC has to upload the details of MOOCs data in respect of each student time to time in University's examinations portal and/or hard/soft copy as per instruction of the Controller of Examinations of the University. This is applicable for University's In-House Programs also.

MOOCs for Mandatory Additional Requirements (MAR)

MOOCs in MAR is provided for encouraging every student to enter in Digital Content form of Education from well-known Universities or organizations.
Students can choose any MOOCs course as per their interest area. There is no credit system for MOOCs in MAR as points could be earned as specified in the scheme and the MOOCs courses which are taken for earning credits for Honours degree will not be considered in MAR purpose.
The validity of uploaded certificates in the University portal is subject to acceptance of appropriate committee/expert review.
Colleges interested to deliver any course(s) online through MOOCs platform, should get vetted from the University regarding mapping of course for credit transfer/assessment process.
This notification supersedes all earlier instructions regarding MOOCs courses.

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MAR for earning AICTE/non-AICTE UG Degree

The MAR Activity Points to be earned for Mandatory Additional Requirements (MAR), for the final year students of the academic year 2018- 19 in AICTE and non-AICTE courses, a re-clarification is provided below:

Academic Year 2018-19	Activity Points
6th Semester (For all three-year courses)	25
8th Semester (For all four-year courses)	25
10th Semester (For five-year course)	25

A student should acquire a total of minimum 100 / 75 activity points throughout 4year / 3year curriculum which should be acquired by earning a minimum of 20 activity points and maximum of 30 activity points in each year of his/her study, which is necessary for uniform distribution of MAR activities throughout the entire period of the academic curriculum of the students.
MAR activities for the students admitted up to the session 2018-19 and for the new session starting from 2019-20, will be in accordance with the following table.

Level of Entry in B.Tech Course	Total duration for earning Points	Minimum Points to be earned
1st Year starting from the academic year 2019-20 onwards	1st to 4th Year	100
2nd Year starting from the academic year 2019-20 onwards (Lateral Entry)	2nd to 4th Year	75

Table – I

Every student, who is admitted to the 4 years B.Tech program prior to the academic year 2019-20, is required to earn minimum number of Activity Points as per Table II in addition to the required academic grades, for getting MAKAUT, WB's B.Tech degree.

Current Semester	Total Minimum Number of Activity Points to be earned During the full course
2nd	100
4th	75
6th	50

Table –II

The courses under MOOCs which have been already taken into consideration i.e., 20 credit courses for awarding B.Tech degree with Honours and 16 credit courses for non-AICTE courses are not to be considered again for awarding activity points for MAR.
In addition to the existing activity point allotment for 12 weeks and 8 weeks MOOCs courses of

short duration (4 weeks/2 weeks) can also be done. 10/5 activity points will be allotted, based on the short course duration of 4weeks/2 weeks respectively. The courses with duration ranging from 18-40 hours must also get proper weightage. (See the following table for details)

Weeks/Hours	Activity Points	Maximum Activity Points
12weeks/40hours	20	40
8weeks/30hours	16	
4weeks/20hours	10	
2weeks/10hours	5	

Table-III

- Any MOOCS already done or registered before the introduction of MAR system is not to be considered again for awarding activity points for MAR. Those courses should not be taken into consideration with retrospective effect.
- A student can also select MOOCs from the MOOCs basket/repository as designed by the University
- for earning activity points for MAR. But the same course cannot be counted for Honours. There should not be any overlapping of MOOCs with regard to MAR and Degree with Honours.
- If any student is unable to get certificate from MOOCs platform after auditing the course, the college
- will extend facility for awarding point after evaluation in consultation with the University.
- The activity points allotted per research publication (Vide Serial No.9 of Table-V) shall carry equal full weights among joint authors, if any, to encourage the students in research work.
- In addition to SWAYAM/NPTEL/Spoken Tutorial the names of all available MOOCS can be
- included. At present, SWAYAM/NPTEL/Spoken Tutorial have only been mentioned (Vide Serial No. 1 of Table V).
- In Serial No. 15 of Table-V, 'Student Chapter' should be read as 'Active Participation in Student
- Chapter', that is, whether the concerned student is an active member of the same.
- A student may earn activity point, being a member of other professional bodies and by participating as a resource person.
- A separate dedicated server is needed for huge data on students' evaluation on the part of the
- colleges. Digital versions of all certificates regarding MAR can be uploaded in the college.
- Every student should upload his/her MAR activity data/certificate in the social media, viz., Facebook/Instagram, which can be counted as part of the documentary evidence.
- Activities must be open-ended, that is, there can be many activities, other than the specified list by
- MAKAUT. College authorities may introduce new activities, with the prior approval of the University.
- The University has introduced new activities as part of MAR, which would encourage
- entrepreneurship ability of the students. Such activities are listed in the following table.

New MAR Activities (In addition to the existing list, Vide Serial No. 22, Table-V)

	Name of the Activity	Points	Maximum Points Allowed
	Self-Entrepreneurship Programme		
a)	To Organize Entrepreneurship Workshop and Programmes	10	20
b)	To take part in Entrepreneurship Workshop and get certificate	5	10
c)	Video Film-Making on Entrepreneurship	10	20
d)	Submit Business Plan on any Project	10	20
e)	To work for start-up/as entrepreneur	20	40

Table-IV

- There must be a Single Point of Contact (SPOC) in each college, who will keep correspondences with the University on MAR activities and his/her name is to be informed to the University. In addition, there should also be a nominated SPOC on behalf of the University for liaison with the colleges.
- Random sample visits and check-ups of individual institutes, as well as digital survey may be
- conducted from time to time to ensure proper implementation of MAR.
- The colleges should maintain MAR files for individual students, preferably in digital format, which can be inspected periodically by the University authorities.
- Different levels of activities in relief camps should carry different weightage for allotting activity
- points in MAR (Vide Serial No. 5 of Table-V).
- Institutions should not raise any subscription from the students in the name of MAR activities

Notes:

1) Every student shall participate in the co-curricular and extra-curricular activities and produce documentary proof to the designated Faculty Members appointed by the Head of the Department/Principal/Director in the respective college. Thereby the student should earn the required points before he/she appears for the Final Examinations.

2) A student's result of his/her Final Examinations will be withheld until he/she completes the minimum activity points by the end of his/her Degree Programme.

3) In every semester, every student is required to prepare a file containing documentary proofs of activities, done by him/her. This file will be duly verified, and activity points will be assigned by the teachers as appointed above, at the end of every semester.

4) Each institution will form a three members committee, the composition of which is to be notified to the University. The committee will finalize the activity points for each student before entering them into the Online Point Entry System (at the URL, as specified by the COE of the University).

5) Every student has to earn at least 75, 100 or 125 activity points for 3-, 4- or 5-year courses respectively. The points earned by the students will be reflected in their mark sheets.

Table V provides a List of Activity Heads and Sub-Activity Heads along with their capping of the activity points that can be earned by the students during the entire course duration.

6)

Sl. No.	Name of the Activity	Points	Maximum Points Allowed
1.	MOOCs (SWAYAM, NPTEL, Spoken Tutorial, EdX, Coursera,etc.)	20 (per course)	40
2.	Tech Fest/Fest/Teachers' Day/Fresher's Welcome		
	a) Organizer	5	10
	b) Participant	3	6
3.	Rural Reporting	5	10
4.	Tree Plantation and up keeping (per tree)	1	10
5.	Participation in Relief Camps		
	a) Collection of funds/materials for the Relief Camp	5	40
	b) To be a part of the Relief Work team	20	
6.	Participation in Debate/Group Discussion/Tech Quiz/Quiz	10	20
7.	Publication of Wall Magazine in institutional level (magazine/article/internet)	10	20
8.	Publication in Newspaper, Magazine and Blogs	10	20
9.	Research Publication (per publication)	15	30
10.	Innovative Projects (other than course curriculum)	30	60
11.	Blood donation	8	16
	Blood donation camp organization	10	20
12.	Participation in Sports/Games		
	a) College level	5	10
	b) University level	10	20
	c) District level	12	24
	d) State level	15	30
	e) National/International Level	20	20
13.	Cultural Programme (Dance, Drama, Elocution, Music	10	2

	etc.)		0
14.	Member of Professional Society	10	20
15.	Student Chapter	10	20
16.	Relevant Industry Visit & Report	10	20
17.	Activities in different Clubs (Photography Club, Cine Club,Gitisansad)	5	10
18.	Participation in Yoga Camp (Certificate to be submitted)	5	10
19.	Adventure Sports with Certification	10	20
20.	Training to under-privileged/differently able	15	30
21.	Community Service & Allied Activities	10	20
22.	Self-Entrepreneurship Programme		
	a) To Organize Entrepreneurship Workshop and Programmes	10	20
	b) To take part in Entrepreneurship Workshop and get certificate	5	10
	c) Video Film-Making on Entrepreneurship	10	20
	d) Submit Business Plan on any Project	10	20
	e) To work for start-up/as entrepreneur	20	40

Table V

College Code and Name:														**Course:**
Student Name:				**University Roll No:**										**Registration No:**
Total number of Semesters:		**Points**	**Max. Points Allowed**	**Points Earned**										
Sl No.	**Activity**			**Sem1**	**Sem2**	**Sem3**	**Sem4**	**Sem5**	**Sem6**	**Sem7**	**Sem8**	**Sem9**	**Sem10**	**Total**
1	***MOOCS (SWAYAM/NPTEL/Spoken Tutorial) per course***													
	For 12 weeks duration/40 Hours	**20**	**40**											
	For 8 weeks duration/30 Hours	**16**												
	For 4 weeks duration/20 Hours	**10**												
	For 2 weeks duration/10 Hours	**5**												
2	***Tech Fest/Fest/Teachers Day/Fresher's Welcome***													

	Organizer	5	10												
	Participant	3	6												
3	Rural Reporting	5	10												
4	Tree Plantation and up keeping (per tree)	1	10												
5	Participation in Relief Camps														
	a) Collection of fund/ materials for the Relief Camp	5	40												
	b) To be a part of the Relief Work Team	20													
6	Participation in Debate/Group Discussion/ Tech quiz /Quiz	10	20												
7	*Publication of Wall magazine in institutional level (magazine/article/internet)*														
	Editor	10	20												
	Writer	6	12												
8	Publication in News Paper, Magazine & Blogs	10	20												
9	Research Publication (per publication)	15	30												
10	Innovative Projects (other than course curriculum)	30	60												
11	Blood donation	8	16												
	Blood donation camp Organization	10	20												
12	*Participation in Sports/Games*														
	a) College level	5	10												
	b) University Level	10	20												
	c) District Level	12	24												
	d) State Level	15	30												
	e) National/International Level	20	20												
13	Cultural Programme (Dance, Drama, Elocution, Musicetc.)	10	20												
14	Member of Professional Society	10	20												
15	Student Chapter	10	20												

16	Relevant Industry Visit & Report	10	20											
17	Photography activities in different Club(Photography club, CineClub, Gitisansad)	5	10											
18	Participation in Yoga Camp (Certificate to be submitted)	5	10											
19	Community Service & Allied Activities	10	20											
20	Adventure Sports with Certification	10	20											
21	Training to under privileged / Differently Abled	15	30											
22	Self-Entrepreneurship Programme													
a)	To organise entrepreneurship programmes andworkshops	10	20											
b)	To take part in entrepreneurship workshop and getcertificate	5	10											
c)	Video film making on entrepreneurship	10	20											
d)	Submit business plan on any project	10	20											
e)	To work for start-up/as entrepreneur	20	40											
Total Points														
Signature of Mentor														
Signature of HOD														

*Please abide strictly to the Notes at the end of the Notice of MAKAUT,WB regarding Mandatory Additional Requirement for earning UG Degree

*Activity Points are to be uploaded in the given format in the specific MAR portal of the University, the link for which will be provided shortly.

*If any student performs activities outside the list enclosed, then he/she can do so with prior approval of the University.

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