

# ENGINEER & SOCIETY



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This book seeks to offer a comprehensive insight into the one of the student learning outcomes “The Engineer and Society” rooted in a profound passion for and mastery of knowledge in the field of outcome-based education. It is published with a personal commitment to disseminate the genuine essence of outcome-based education via [rubricsedu.com](http://rubricsedu.com). While there is an abundance of articles, research literature, and various forms of information available on the topic of The Engineer and Society, this work endeavours to shed light on the subject by providing a few classical examples. Gratitude is extended to a higher power for this opportunity and also we would like to acknowledge the support being provided by the Management of NSRIT.



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# PART ONE

## Introduction

The student learning outcome of 'The Engineer and Society' constitutes a comprehensive field of study, frequently encompassing the nuanced exploration of the social, ethical, and environmental facets inherent in engineering practices. This academic pursuit delves into the intricate interplay between engineering and the societal milieu, requiring an adept comprehension of the intricate intersections between technology and the broader human context. Engineers navigating this domain are tasked with discerning the ethical implications of their professional decisions, cognizant of the pervasive socio-cultural, economic, and political influences. Furthermore, this discipline mandates a sophisticated grasp of environmental sustainability, with an emphasis on the intricate balance between technological progress and ecological preservation. Effectively addressing these imperatives entails equipping engineering practitioners with the communication skills necessary to articulate complex technical information to diverse audiences, spanning from the general public to policymakers. Ultimately, the study of 'The Engineer and Society' thus entails a multifaceted intellectual engagement, necessitating a profound appreciation of the ethical, social, and environmental dimensions that coalesce within the realm of engineering.



# PART ONE

## Statement of 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.**

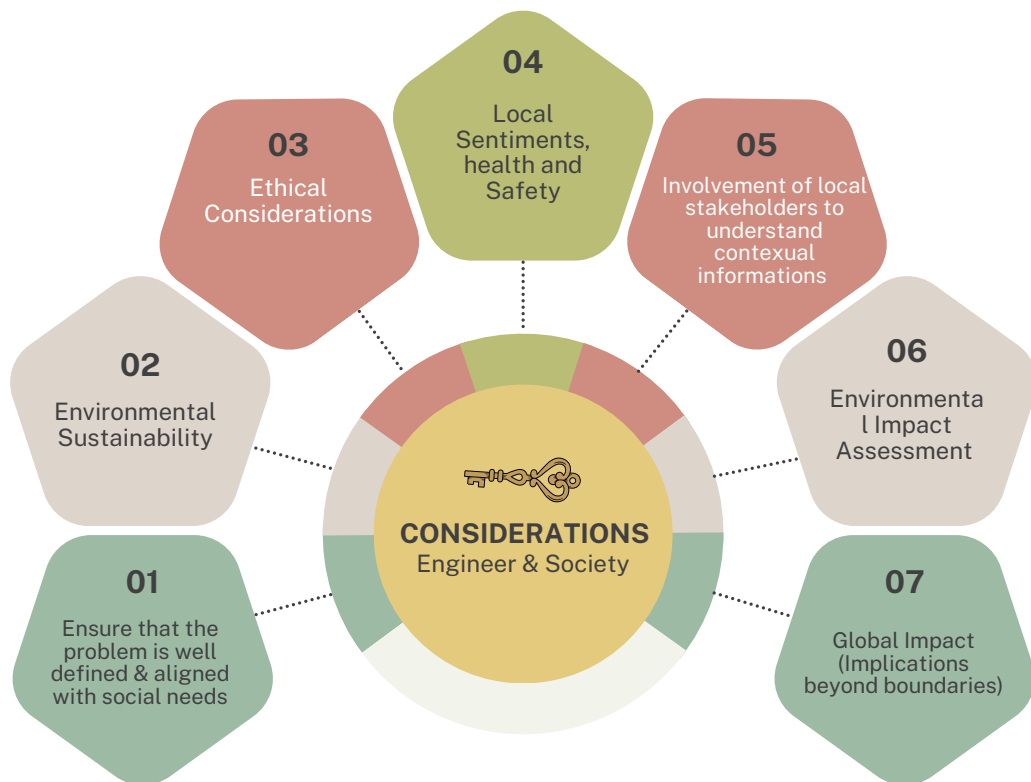
**How the solution should be?:** Developing an engineering solution in accordance with the student learning outcome "Engineer and Society" requires a comprehensive and thoughtful approach. This entails not just focusing on technical aspects but also taking into account the wider societal, ethical, and environmental considerations. To be specific, offering an engineering solution involves more than just technical expertise; it also encompasses the additional dimensions mentioned earlier. To be more specific, the following are the key parameters of consideration and understanding is necessary before providing a sustainable and viable solution.

- 1. Environmental sustainability**
- 2. Ethical considerations**
- 3. Local sentiments**
- 4. Involvement of local stakeholders**
- 5. Understanding the other contextual knowledge i.e. the locally available information**
- 6. Global impact and environmental impact assessment**



# PART ONE

## Statement of the “Engineer and Society”



The primary challenge now lies in determining whether our curriculum truly captures the essence of the key considerations mentioned above. Therefore, this concise book strives to empower readers to implement Engineering and Society in a manner that aligns with the genuine expectations.

# PART TWO

## Present scenario of curriculum design, assigning courses and content deliverables

In the intricate endeavor of crafting and refining curricula, a critical imperative emerges for curriculum developers, educators, and administrators to conscientiously deliberate upon pivotal courses. These courses must meticulously encapsulate and deliver curriculum components tailored to address the nuanced spectrum of desired learning outcomes. The discerning consideration of these imperatives within the dynamic milieu of curriculum design and revision is quintessential, as it shapes the educational landscape with precision and foresight.

Since 2014, the ascendancy of outcome-based education has markedly surged across nearly all Higher Education Institutions (HEIs). Ongoing efforts persist to disseminate awareness, empowering institutions to cultivate curriculum designs grounded in outcomes. Educational establishments ardently strive to formulate outcome-centric curricula, concurrently devising judicious assessment instruments to appraise targeted student learning outcomes. This endeavor is undertaken with a dedicated commitment to perpetuate a cycle of continuous improvement, wherein the assessment and evaluation of these outcomes serve as catalysts for refinement within the educational sphere.





# PART TWO

## Present scenario of curriculum design, assigning courses and content deliverables

Venturing into uncharted realms, following the implementation of the National Education Policy 2020, India has witnessed a marked upswing in the endeavor to shape outcome-based curriculum designs seamlessly interwoven with the imperatives of industry. This surge assumes heightened significance against the backdrop of an evolving industrial landscape, wherein the imperative is to craft educational outcomes steeped in skill-intensive, industry-aligned paradigms reflective of authentic professional scenarios. In the contemporary milieu, industries no longer merely emphasize core domain knowledge; instead, they advocate for a nuanced, multifaceted education. Consequently, educational institutions find themselves burdened with an augmented responsibility, tasked with providing industry-integrated, outcome-centric education. This formidable undertaking necessitates the assembly of a cadre comprising high-caliber Subject Matter Experts (SMEs) and industry collaborators, charged with the creation of a resilient curriculum. Simultaneously, the elevation of educators' skill sets emerges as imperative, ensuring the meticulous crafting and dissemination of such outcomes-driven education, all the while preserving its intrinsic essence.





# PART TWO

## Present scenario of curriculum design, assigning courses and content deliverables

Despite considerable endeavors in the recent epoch, substantial challenges persist ubiquitously within Higher Education Institutions (HEIs), encompassing three pivotal domains.

1. Firstly, there exists a formidable challenge in elevating the proficiency of educators to apprehend the nuanced essence intrinsic to the philosophy of the outcome-based educational framework.
2. Second, there is a pressing need to empower instructors in the comprehensive spectrum of designing, developing, delivering, assessing, and evaluating curricula rooted in outcomes
3. Lastly, establishing an outcome-centric educational ecosystem poses a complex challenge, necessitating a heightened awareness campaign that sensibilizes all stakeholders, with a particular focus on the paramount contributors—the students. Addressing these challenges demands a concerted and strategic approach to fortify the educational landscape with a foundation firmly grounded in the principles and intricacies of outcome-based education

# PART TWO

## Present scenario of curriculum design, assigning courses and content deliverables

In numerous academic institutions, the authors express genuine remorse as they observe, drawing from personal insights, a notable dearth of relevance and alignment with intended learning outcomes. This observation is particularly pertinent within the sphere of "Engineer and Society." The curriculum deliverables, it is regretfully noted, do not systematically equip graduating students with the capacity to provide engineering solutions, especially in the realms of ethics, socio-economic considerations, sustainability, and health and safety. Astonishingly, these educational materials neglect the essential contextual intricacies intrinsic to these multifaceted issues. Consequently, the educational framework appears to fall short in cultivating a holistic and applied understanding of the intersections between engineering practice and societal dynamics, thus warranting a critical reevaluation and enhancement of the existing curriculum.

Thus, there is a compelling imperative for curriculum design that authentically caters to the intended learning outcomes in their true essence.



# PART THREE

## Crafting of Curriculum

A curriculum crafted to realize the student learning outcome of "Engineer and Society" ought to amalgamate engineering education with a profound comprehension of societal ramifications. Broadly speaking, according to the authors, these courses can be effectively taught by integrating theory, practical application, and field-oriented projects. Relying solely on a theoretical framework will prove insufficient in meeting this student learning outcome, as it necessitates a deeper understanding of contextual information and interdisciplinary knowledge.

The following presents an illustrative framework:

**Grounding in Engineering Principles:** Foundational courses encompassing essential engineering principles, methodologies, and technical competencies.

### **Sustainability Integration**

- Incorporating sustainability principles into engineering design and processes.
- Undertaking projects that underscore sustainable practices, including the design of energy-efficient systems or the implementation of waste reduction strategies by conducting environmental impact assessment (EIA)



# PART THREE

## Crafting of Curriculum

### **Health and Safety Practices**

- Specialised modules addressing health and safety regulations in engineering projects
- Hands-on exercises involving the assessment of risks and the application of safety measures.

### **Ethics and Professional Responsibility**

- Modules delving into ethical considerations within engineering, incorporating case studies illustrating ethical dilemmas
- Discussions centered on the obligations of engineers to society.

### **Engineering for Community Development**

- Joint initiatives with local communities to address their distinct engineering requirements
- Incorporation of case studies focused on community development

### **Socio-Economic Impact Analysis**

- Programs concentrating on the economic and social repercussions of engineering projects
- Examination of case studies scrutinizing projects with notable societal implications, such as infrastructure development or initiatives in renewable energy.



# PART THREE

## Crafting of Curriculum

### **Practical Utilizations in Real-world Contexts**

- Inclusion of engineering exemplars exemplifying their societal impact, such as the conception of water purification systems for marginalized communities or the innovation of assistive technologies

### **Interdisciplinary and Trans-disciplinary Partnership**

- Prospects for collaborative projects spanning engineering, social sciences, and humanities
- Conducting joint seminars or workshops with experts across diverse fields to deliberate on societal challenges.

### **Continuous Evaluation and Contemplation**

- Routine assessments gauging not solely technical adeptness but also ethical discernment and societal cognizance
- Deliberative sessions prompting students to ponder upon the societal repercussions of their engineering choices

Through the amalgamation of these components, the curriculum not only facilitates the assimilation of engineering principles but also cultivates a comprehensive comprehension of the students' roles as conscientious engineers who actively contribute to societal well-being.

# PART THREE

## Crafting of Curriculum

The infusion of tangible, real-world engineering instances serves to augment the pragmatic applicability of theoretical knowledge, bridging the conceptual realm with practical exigencies. By immersing students in interdisciplinary collaborations, ethical quandaries, and societal analyses, the curriculum engenders a multifaceted skill set and an acute awareness of the broader impact of engineering endeavors.

This holistic approach not only nurtures technical proficiency but also instills a profound sense of responsibility, prompting graduates to navigate the intricate intersections between engineering solutions and societal needs. Consequently, the curriculum transcends mere academic enrichment, serving as a crucible for the cultivation of engineers who possess both the theoretical acumen and the ethical discernment requisite for effecting positive societal change.

This specific learning outcome holds paramount significance for a triumphant and fulfilling engineering career, as it necessitates the engineer to adeptly don the perspective of the customer, demonstrating a keen ability to empathize and comprehend the client's standpoint. This renders the engineer a more conscientious professional and an exemplary member of the societal fabric.



# PART THREE

## Crafting of Curriculum

**Example for a Civil Engineering Graduate:** In the context of development of urban infrastructure, the engineering students collaboratively engage with local communities to address specific requisites, such as the enhancement of transportation systems.

In this undertaking, students not only apply their technical acumen in formulating and executing improvements to infrastructure but also immerse themselves in exhaustive socio-economic impact assessments. They meticulously evaluate the project's ramifications on local residents, businesses, and the ecological milieu. The planning process is infused with ethical considerations, notably focused on minimizing disruptions and ensuring universal accessibility for all community members.

Throughout the project's duration, students actively interface with community constituents via town hall meetings and feedback sessions, actively incorporating their perspectives into the design and decision-making framework. This hands-on experience serves as a catalyst for students to discern the broader societal implications of their engineering determinations, fostering a profound comprehension of the intricate interplay between engineering solutions and the holistic well-being of the community. The gauge of the project's success transcends technical metrics, encompassing the positive imprint it leaves on the quality of life and societal fabric of the community.





# PART THREE

## Crafting of Curriculum

**Example for a Computing Engineer:** The creation of an all-encompassing and accessible software application designed to meet a specific societal requirement provides a concrete illustration. Consider, for instance, a project centered on crafting a communication tool tailored for individuals with diverse abilities, encompassing those with visual or auditory impairments.

Within this project, graduates in computing engineering would collaborate closely with accessibility specialists and end-users from the community, each possessing unique abilities. The process of designing the software necessitates not only technical proficiency in coding and system architecture but also a profound comprehension of the varied needs and obstacles confronted by potential users.

Throughout the developmental stages, ethical considerations assume paramount importance, ensuring that the software prioritizes inclusivity, data security, and user privacy. The computing engineers actively engage with the community through user testing sessions and feedback forums, continuously refining the application based on real-world usage and input from the community.

This experiential undertaking compels computing engineering graduates to transcend the realm of mere technical adeptness, instilling within them a profound consciousness of the societal repercussions of their endeavors.



# PART THREE

## Crafting of Curriculum

The project's success extends beyond the mere functionality of the software, encompassing its affirmative contribution to augmenting accessibility, nurturing inclusivity, and elevating the quality of life for individuals within the community possessing diverse needs.

**Example for Chemical Engineer:** A project centered on fostering sustainable and eco-friendly practices within the pharmaceutical industry is envisioned. Picture a scenario wherein chemical engineering graduates collaborate to devise an innovative production method for pharmaceuticals, emphasizing the minimization of environmental impact and the optimization of resource efficiency.

Within this project, graduates would not only apply their technical proficiency in chemical processes but also undertake an exhaustive analysis of the ecological and societal ramifications inherent in pharmaceutical manufacturing. Their exploration may involve investigating alternative raw materials, crafting processes aimed at waste and emission reduction, and conducting a holistic evaluation of the production method's sustainability.

Ethical considerations assume a pivotal role in the decision-making process, ensuring that pharmaceutical production aligns with safety regulations, environmental benchmarks, and addresses healthcare needs across diverse communities. Graduates actively incorporate stakeholders, encompassing environmental experts, healthcare professionals, and community representatives, into the project's planning and decision-making phases.



# PART THREE

## Crafting of Curriculum

This hands-on experience serves as a crucible for cultivating a profound understanding among chemical engineering graduates regarding the broader societal and environmental impacts intrinsic to their work. The project's success is gauged not merely by the technical prowess exhibited in pharmaceutical production but also by its affirmative contributions to sustainability, environmental stewardship, and societal well-being. This comprehensive approach underscores the imperative for chemical engineering graduates to discern and navigate the intricate interplay between their technical acumen and the societal milieu in which their engineering solutions operate.

Moving beyond these instances, there has been a noticeable surge in the integration of Community Service Projects (CSP) in recent years. This trend is empowering learners to comprehend societal needs, molding them into responsible citizens. In this regard, curriculum designers might consider linking this curriculum component to the student learning outcomes of "The Engineer and Society." This approach provides students with the opportunity to engage with local communities, gaining insight into their needs and developing substantiated solutions. The incorporation of CSP stands out as a valuable tool for actively involving learners with local communities.



# PART THREE

## Crafting of Curriculum

Engaging with local communities provides valuable insights into locally available information, helping understand the challenges associated with addressing prevalent issues and foreseeing potential consequences. Consider a scenario involving a Civil Engineer planning to construct a residential apartment building on land that was once a lake 25 years ago and has since been filled with soil. If the Civil Engineer is aware of this information before commencing construction, it would greatly assist in conducting thorough soil testing and implementing necessary measures to address the impact of the proposed multi-storeyed building on the safety of the communities.

Therefore, it is highly recommended for engineers, to actively participate by organising multiple town hall meetings with local communities. This engagement, coupled with a well-prepared presentation, facilitates a comprehensive understanding of the requirements and potential impacts of the proposed solution.

Therefore, the meticulous revision of the curriculum demands immediate attention to incorporate such essential curricular elements, ensuring a thorough consideration of the student learning outcome, particularly in **The Engineer and Society**. Additionally, it is imperative to contemplate whether the curriculum of our institution presently fulfills this imperative, addressing all pertinent student learning outcomes.

# PART FOUR



## Final Thought

To be exceedingly precise, curriculum designers ought to concentrate on specific parameters when crafting the curriculum to effectively address the student learning outcome, particularly in The Engineer and Society.

- **Curriculum Design:** The curriculum should encompass courses that are meticulously mapped or anticipated to significantly contribute to the achievement of the student learning outcome, integrating theoretical knowledge with practical application, and incorporating field-oriented projects or community service projects (CSP)
- **Deliverables:** Furthermore, the deliverables of the curriculum must offer ample opportunities for learners, providing substantial content to cultivate proficiency in fulfilling this learning outcome. This includes a thorough understanding of Environmental Impact Assessment (EIA), active participation in town hall meetings with the local communities through community service oriented activities, and due consideration of ethics, safety and health aspects. The incorporation of case studies also holds significant importance in mimicking and visualizing real-world engineering challenges
- **Assessment Tools:** Most importantly, appropriate design, development and implementation of assessment tools to assess and evaluate

# PART FOUR



## Final Thought

In the assessment process, it is crucial to meticulously evaluate certain parameters by establishing rubrics with weights that may be either varied or proportionally equal, depending on the specific requirements. These parameters include:

1. Evaluation of contextual knowledge, if available
2. Conducting town hall meetings with local communities and assessing the impact or influence of such engagements
3. Deliberation on ethical considerations, safety, and health
4. Ultimately, conducting an impact assessment on the proposed solution that extends beyond local boundaries
5. Consideration on the process of continuous improvement on the effectiveness of the solution over a period of time in the society/community



## THE FIRST

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