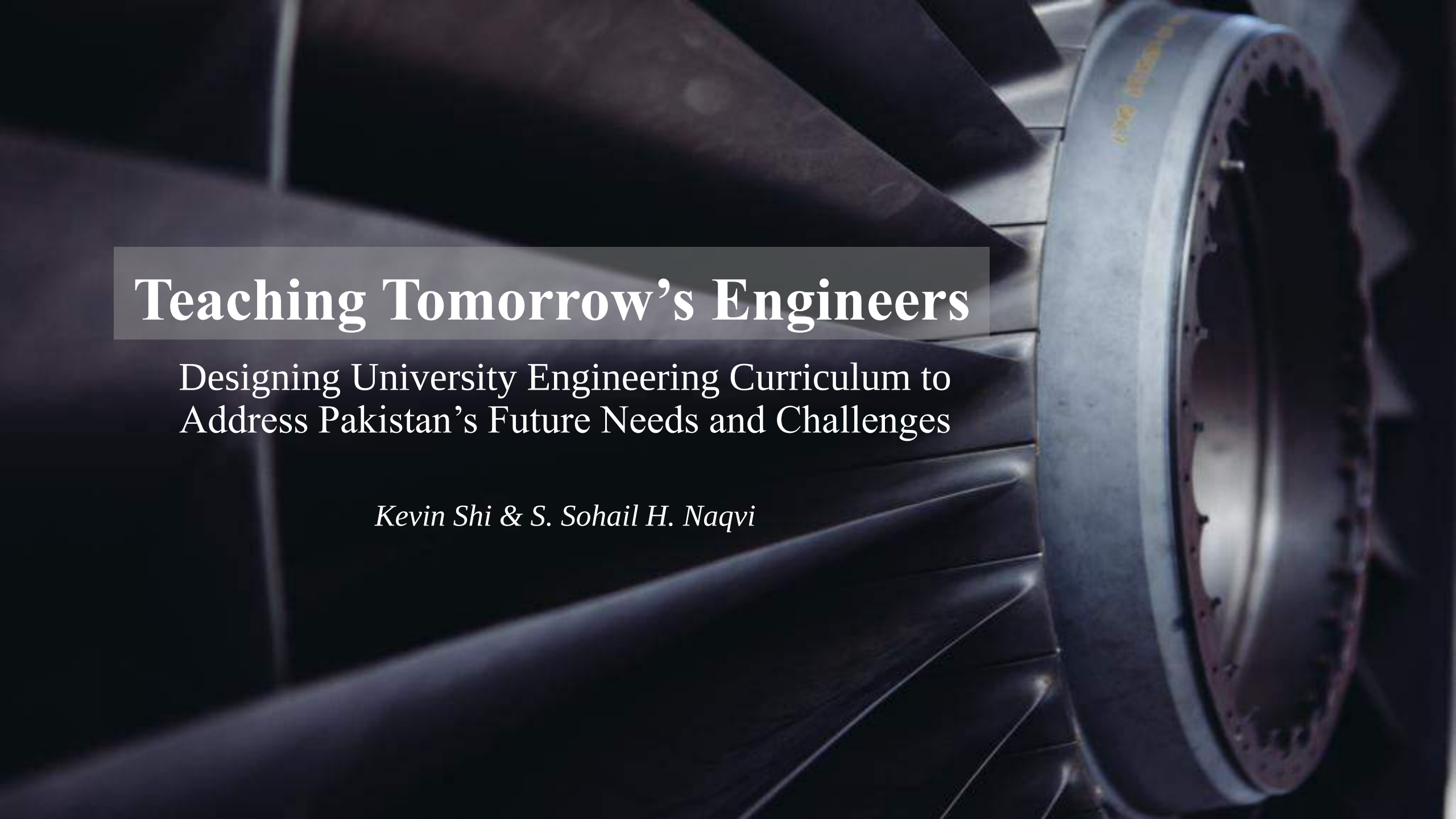


Teaching Tomorrow's Engineers

Designing University Engineering Curriculum to Address Pakistan's Future Needs and Challenges

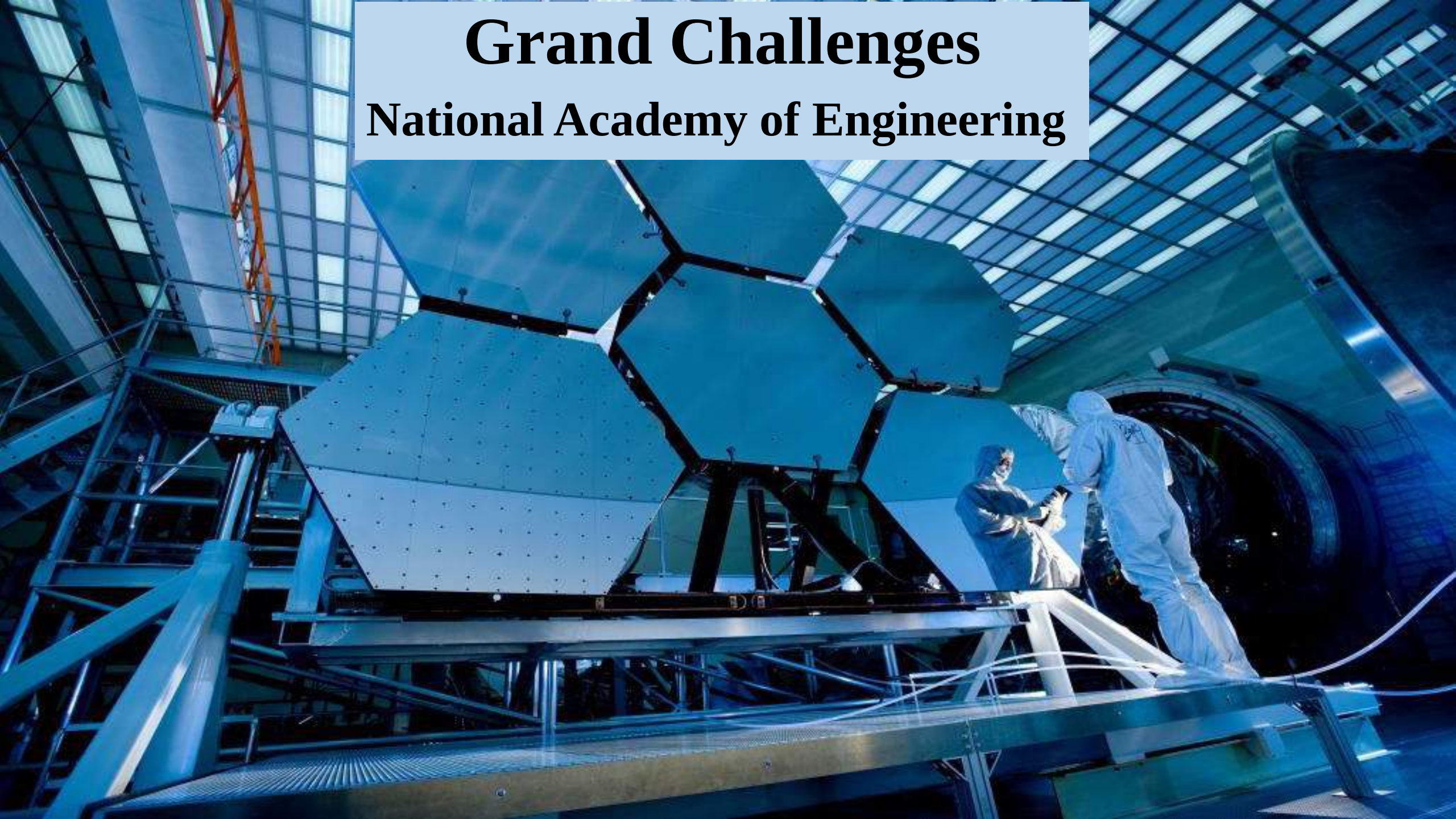
Kevin Shi & S. Sohail H. Naqvi

Engineering Miracles

- Steam Engine
- Automobile
- Radio and Television
- Telephones
- Airplane
- Internet
- Spacecraft
- Nuclear technology

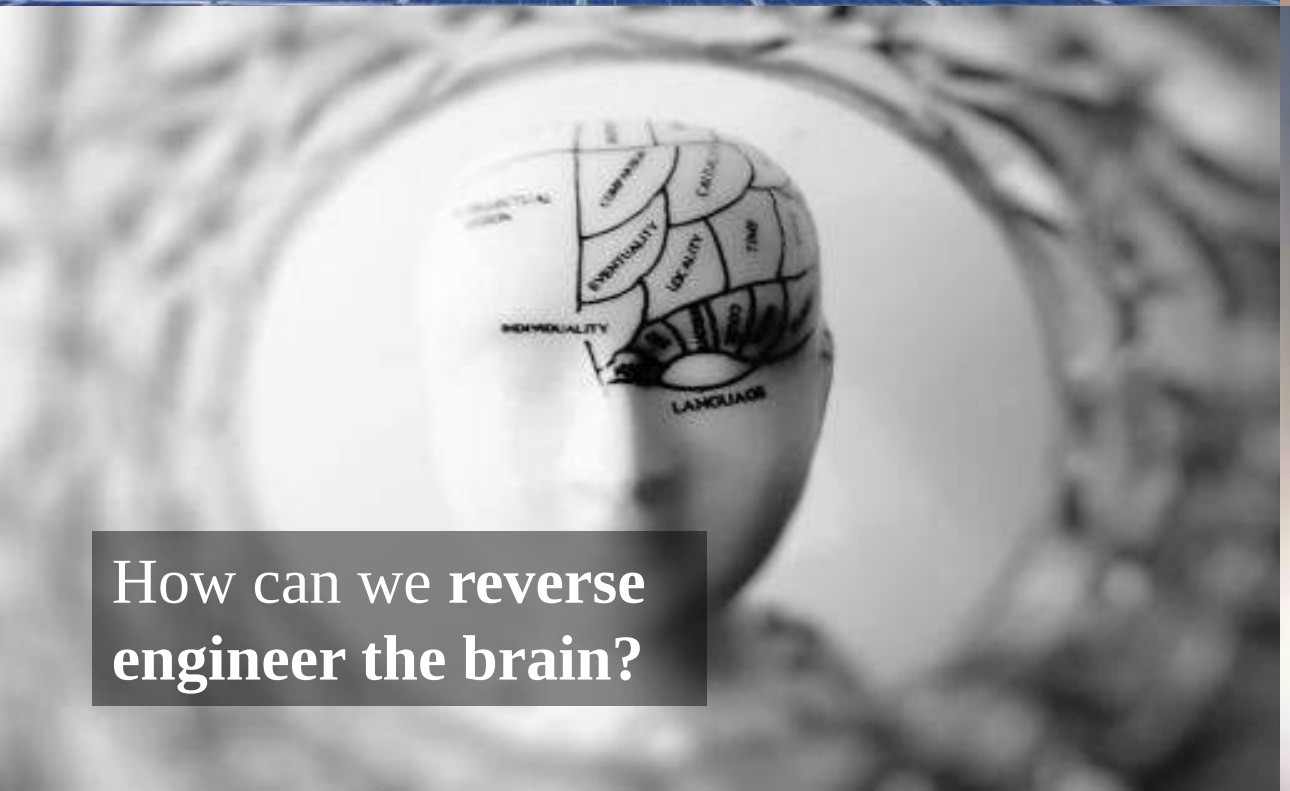
Grand Challenges

National Academy of Engineering



How can we make **solar energy** economically viable?

How can we advance **personalized learning**?



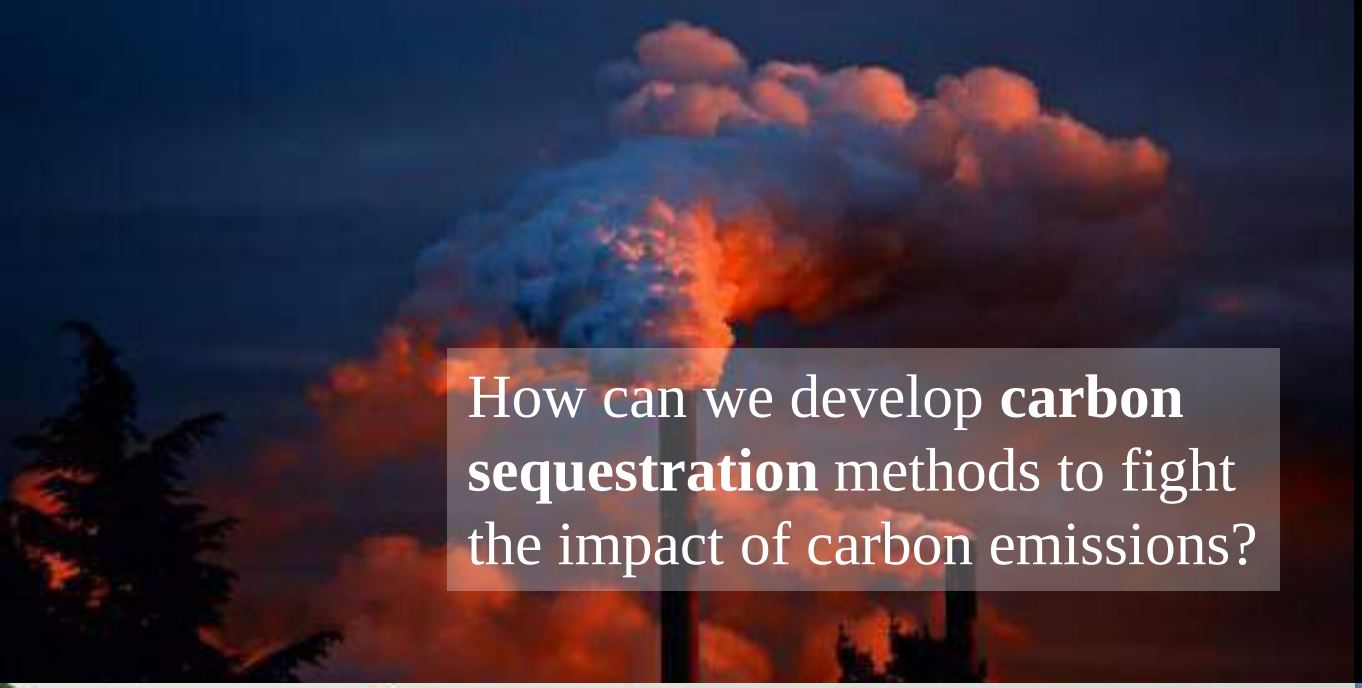
How can we **reverse engineer the brain?**


How can engineering lead to advancements in **medicine**?


How can we advance **health informatics**?


How can we better secure **cyberspace**?


How can we improve access to **clean water**?



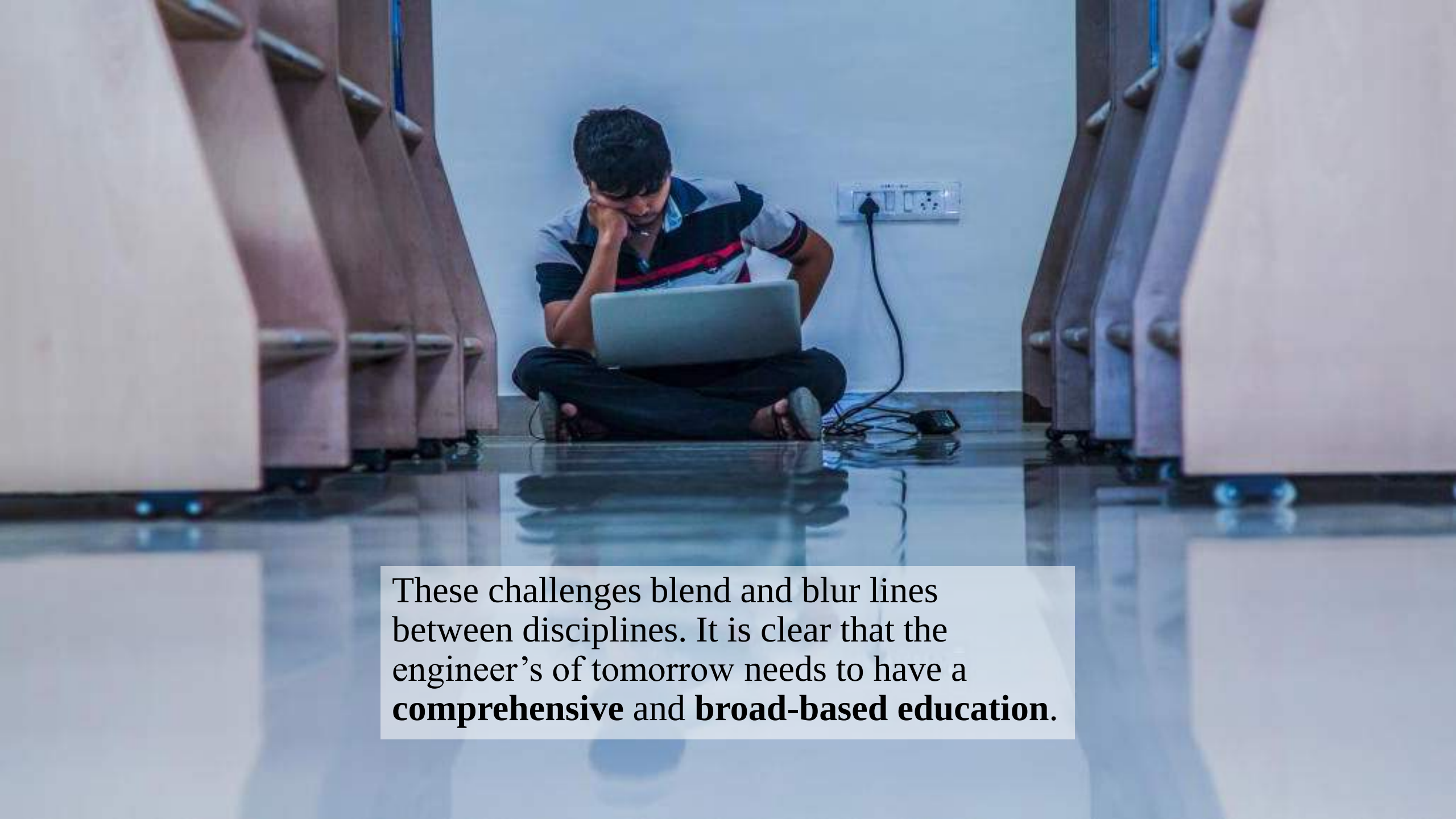
How can we develop **carbon sequestration** methods to fight the impact of carbon emissions?

How can we better harness energy from **fusion**?

How can we manage the **nitrogen cycle**?

How can we prevent **nuclear terror**?


How can we restore and improve **urban infrastructure**?
How can we engineer the tools for further **scientific discovery**?

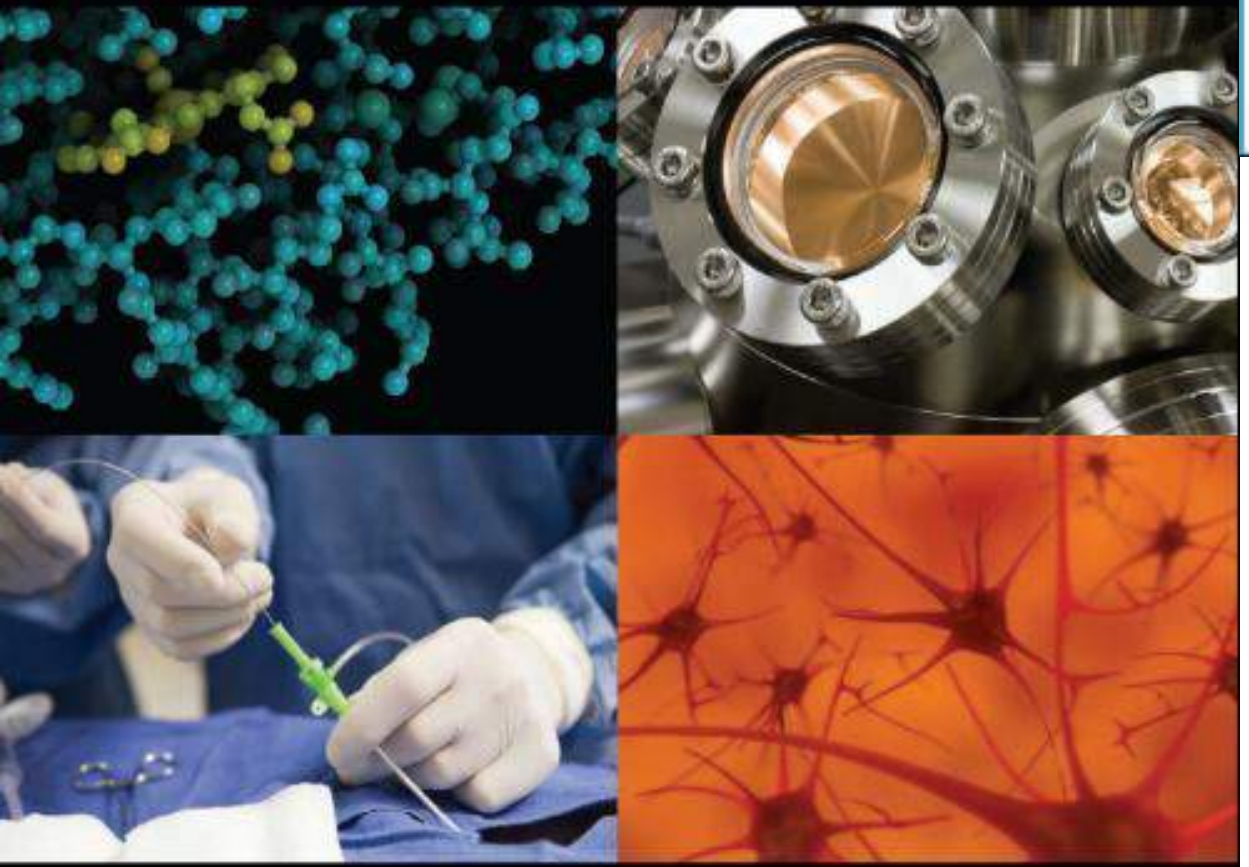


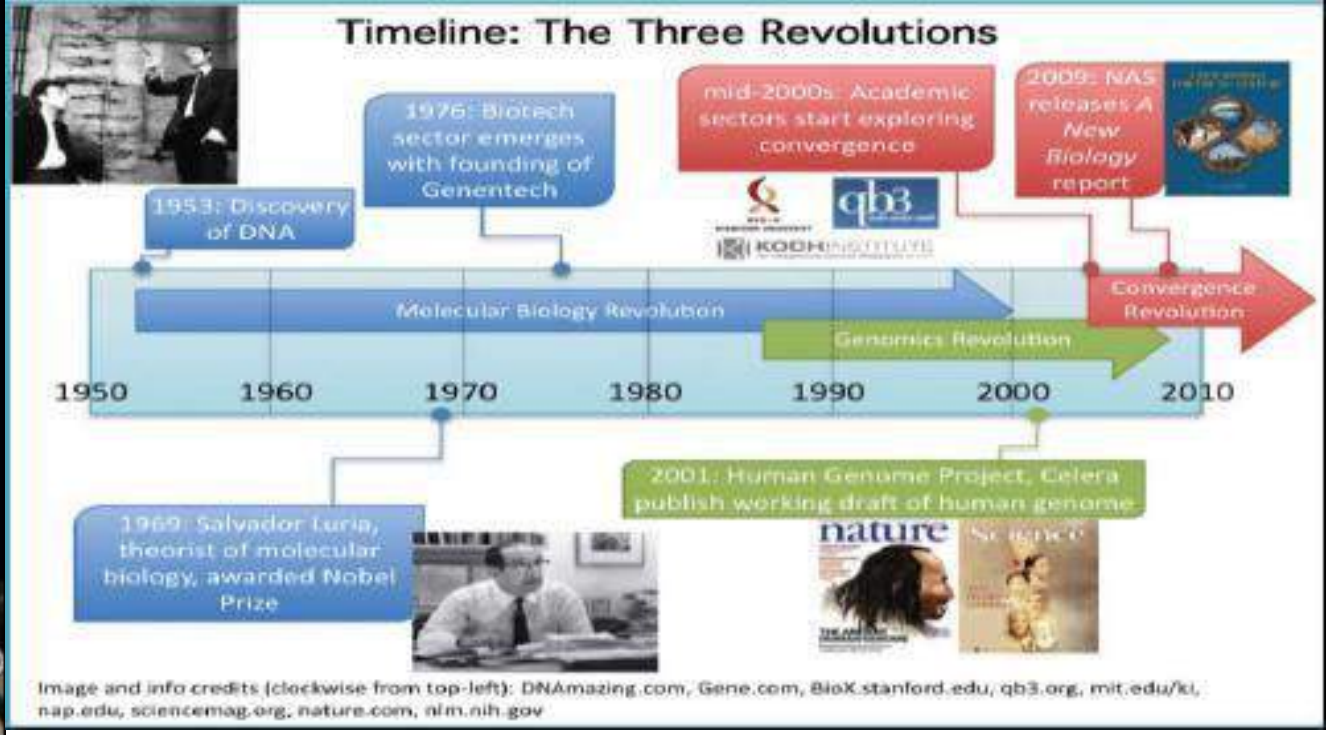
These challenges blend and blur lines between disciplines. It is clear that the engineer’s of tomorrow needs to have a **comprehensive** and **broad-based education**.


People are now talking of **convergence**, the merging of technologies and disciplines to create an array of new techniques and opportunities.

The Third Revolution:

The Convergence of the Life Sciences, Physical Sciences, and Engineering





This report is presented to the health science research community to help delineate an important new research model—convergence—which draws on an ongoing merger of life, physical and engineering sciences.

This new model is being adopted at many institutions in different forms. The past decade has seen the evolution of new interdisciplinary research areas—bioinfomatics, synthetic biology, nanobiology, computational biology, tissue engineering, biomaterials, and systems biology are examples. These new fields share a comparable, underlying research model, convergence, and there is a need to see them as a unity in order to ensure their continued progress. The successful application of this model will require not simply collaboration between disciplines, but true disciplinary integration.

Does Pakistan's Engineering Curriculum Rise to the Challenge?

The world's cadre of engineers will seek ways to put knowledge into practice to meet these grand challenges.

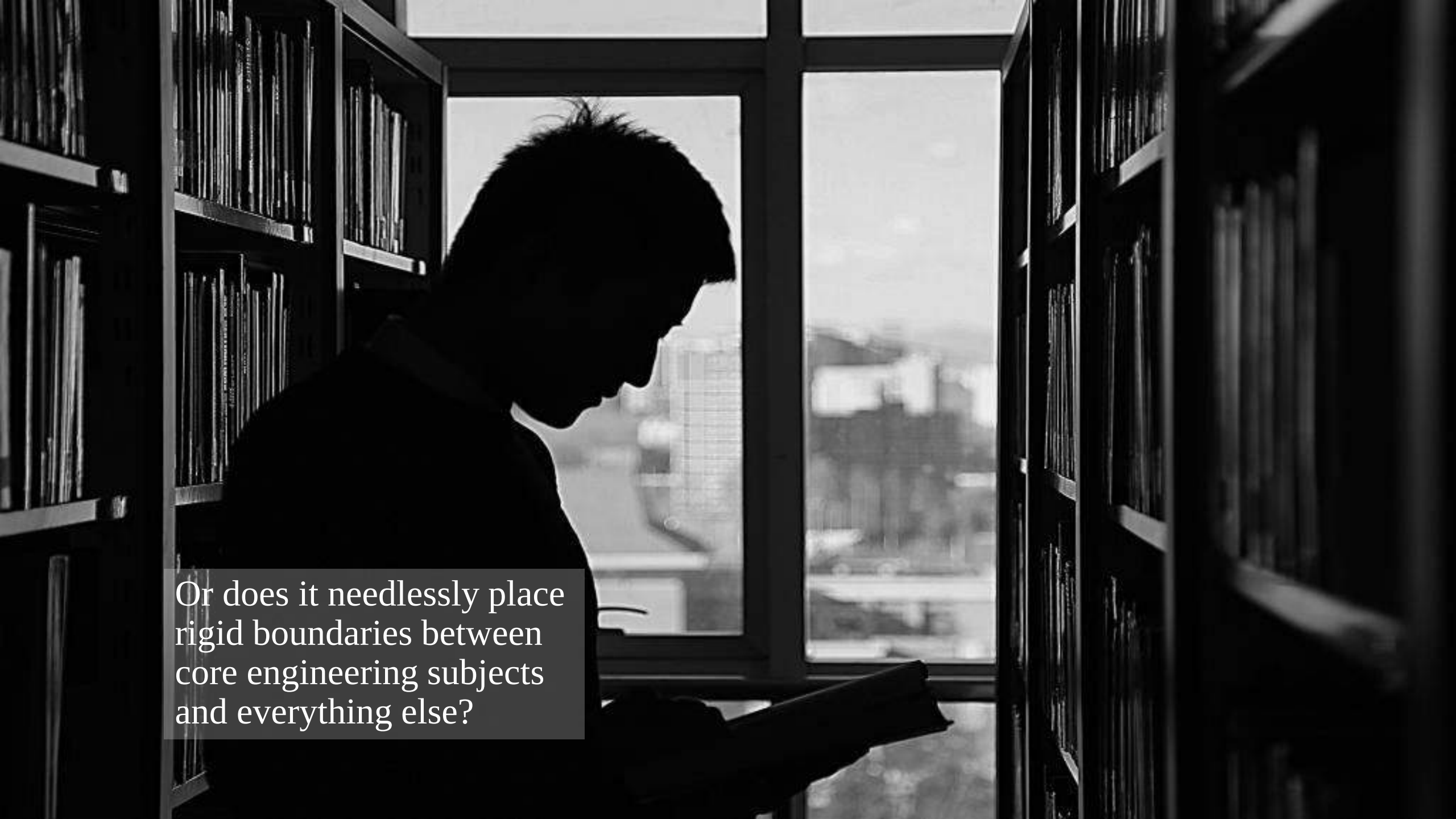
Applying the:

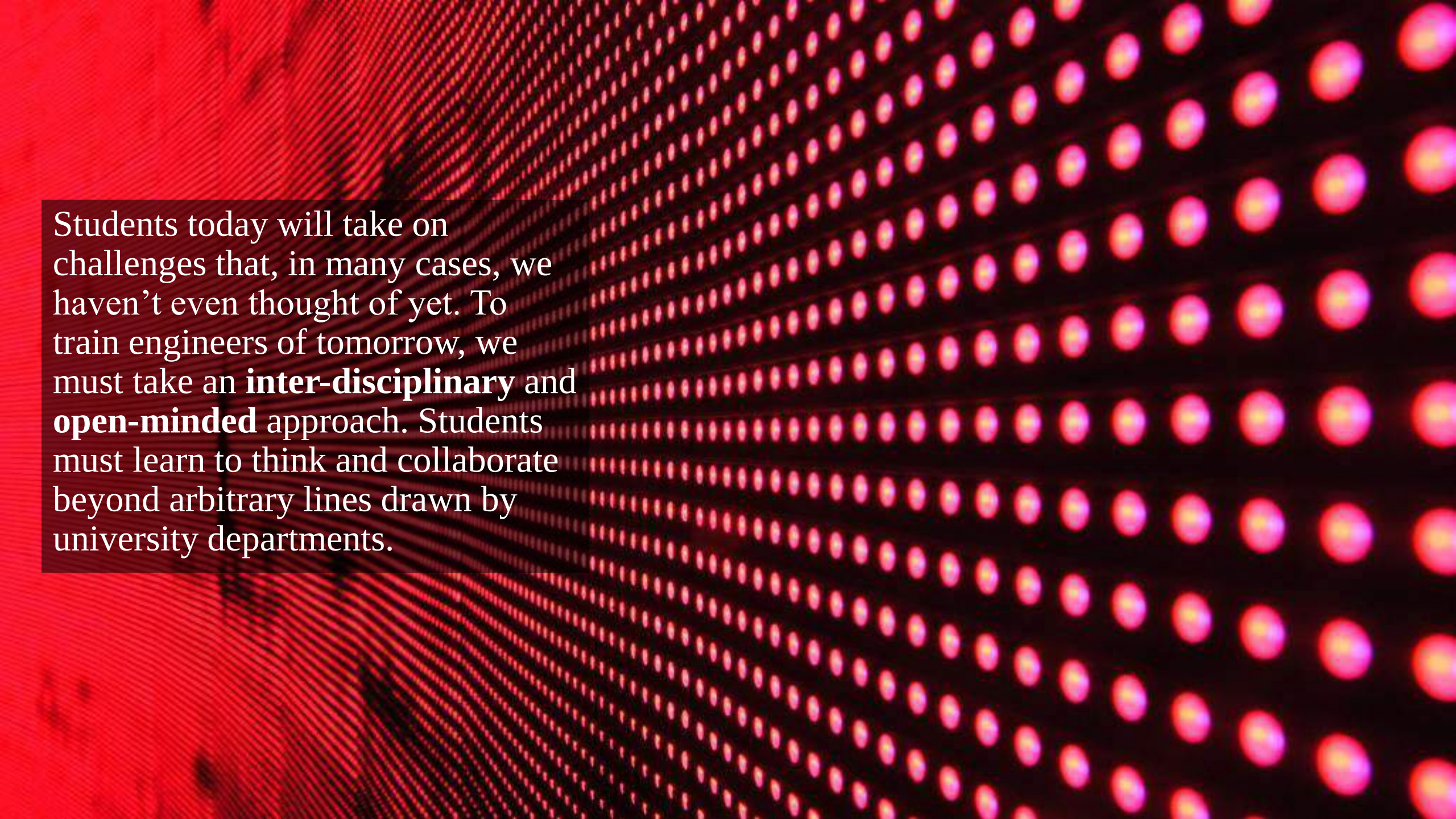
- Rules of reason,
- Findings of science
- Aesthetics of art
- Spark of creative imagination

Engineers will continue the tradition of forging a better future.

Knowledge Area	PEC/HEC	Purdue	Georgia Tech
Humanities	19-21	24	32
Management Sciences (encouraged but elective in case of LUMS)	6	-	-
Natural Sciences	19-20	33-35	34

Knowledge Area	PEC/HEC	Purdue	Georgia Tech
Computing	9	-	3
Engineering Foundation	29	25	30
Major Based Core (Breadth)	19-20	9-11	-
Major Based Core (Depth)	17-18	7-10	23


Or does it needlessly place rigid boundaries between core engineering subjects and everything else?


Students today will take on challenges that, in many cases, we haven’t even thought of yet. To train engineers of tomorrow, we must take an **inter-disciplinary** and **open-minded** approach. Students must learn to think and collaborate beyond arbitrary lines drawn by university departments.

2013

The seven top characteristics of success at Google are all soft skills: being a good coach; communicating and listening well; possessing insights into others (including others different values and points of view); having empathy toward and being supportive of one's colleagues; being a good critical thinker and problem solver; and being able to make connections across complex ideas.

2017

Project Aristotle shows that the best teams at Google exhibit a range of soft skills: equality, generosity, curiosity toward the ideas of your teammates, empathy, and emotional intelligence. And topping the list: emotional safety. No bullying. To succeed, each and every team member must feel confident speaking up and making mistakes. They must know they are being heard.

Evidence from the Top

Companies at the forefront of technology, such as Google, are increasingly realizing the importance of learning and skills outside hard engineering subjects.

Source: Strauss, Valerie. "The surprising thing Google learned about its employees – and what it means for today's students." *Washington Post.* December 20, 2017

Conclusion

- The challenges that Pakistan and the world face currently and in the future are complex, and require outside-the-box thinking and expertise across disciplines.
- Employers, researchers, and universities are increasingly prioritizing a broad-based and inter-disciplinary education.
- The focus of our Curriculum needs to be the “Spirit” not the “Form”
- We must not isolate engineering students from the other hard sciences, the humanities, and social sciences.