



Eidgenössische Technische Hochschule Zürich  
Swiss Federal Institute of Technology Zurich

## Written Exam 529-0043-00S - Analytical Strategy Winter 2016

---

Vorname : \_\_\_\_\_ Name : \_\_\_\_\_

---

- Zeit: 60 Min. Teilen Sie sich Ihre Zeit gut ein.  
*Time: 60 min, organize your time carefully.*
- Sie können auf Englisch oder Deutsch antworten  
*Answers are accepted in German or English.*
- Es sind alle Hilfsmittel mit Ausnahme von Computern und Telekommunikation erlaubt.  
*It is allowed to use all resources except for computers and communication devices.*
- Unleserliche Texte, unklare Formulierungen oder unsaubere Skizzen können nicht bewertet werden. Bitte bemühen Sie sich um eine saubere Darstellung.  
*Unreadable text, unclear formulations or graphs are not graded. Please try to use clear illustrations and descriptions*
- Schreiben Sie jedes abzugebende Blatt einzeln mit Ihrem Namen und Vornamen an.  
*Label every page with name and surname.*
- Dieses Deckblatt ist ausgefüllt abzugeben. Die Aufgabenstellung ist ebenfalls einzureichen.  
*Please fill in the first page. Hand in all pages including cover page and questions.*
- Wir bitten Sie um Fairness und wünschen Ihnen viel Erfolg!  
*We ask you for fairness and wish you good luck!*

## Prüfung Winter 2016 / Analytical Strategy

African Continent, in the year 2050: bacteria (Cholera, Legionella, Plague, Pneumonia, Tetanus, etc.) are causing serious health threats, in particular emerging strains that are completely resistant against classical broadband antibiotics. What is also worrying is that many of these strains are much more aggressive, and can lead to death of a patient within a short time. Luckily, there are novel high-tech antibiotic drugs available that target individual bacterial strains, and are very specific for and effective against these. They are also very expensive. This, therefore, requires very rapid bacterial typing (typing is defined as a procedure for identifying types and strains of bacteria). Typically emergency rooms in hospitals have very little time to decide what kind of infection a patient might have to administer the correct, specific high-tech antibiotic. Conventional bacterial typing methods (bacterial culture followed by optical microscopy; genetic sequencing of bacteria; etc.) are all too slow. Novel, rapid on-line methods are required.

Answer the following questions:

1. Make general suggestions for three different methods that could potentially perform bacterial typing very rapidly. Address the following questions:
  - what property of the bacteria will be used for typing?
  - what analytical method is suitable to detect this property?
  - which easily accessible samples from the human body could be used for the test?
2. Choose one of the methods proposed in question 1 and describe it in detail. Describe a protocol for on-line / real-time measurement. In particular, think of the following aspects: What sample from the patient can be used? Sampling method? Analytical method? Time requirement? Safety and environmental concerns?
3. Generally, the data generated by typing methods are not molecular identities, but only “features” (examples: retention times of chromatographic peaks; responses from different pads of a multiplexed sensor). How would you treat the data to arrive from “features” obtained in an on-line typing measurement (potentially 100s to 1000s of “features”) to the clear identification of a bacterial type? What problems do you foresee?
4. Very often, patients do not even make it to a hospital after contracting an infection, because the travel times are too long. Describe a strategy to deploy the method you propose in every village, where it can be operated by untrained personnel, and with minimal infrastructure. What aspects are important such that the method works reliably?