Tutorial – 1
(ME226: Mechanical Measurements)

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Problem 1

- In ancient times, a river was a natural boundary demarcating two kingdoms – say 'N' and 'S'. People from both the kingdoms will use the water from the river for irrigation and other purposes.

- A dispute has arisen saying that 'N' kingdom people are diverting more than half of the river water towards their kingdom.

- You, as an IIT Engineer, is called to resolve the dispute. What will you do?

- Get agricultural land area –
- Map all irrigation canals – measure each size of canal
- Types of crop grown – consumption of water depends on that
- Set up meter quantifying the water taken in each canal
- More canals upstream or not
- Use of pump by any kingdom
- Find flow of river upstream and downstream of the kingdom
- Measure Reynolds number and deduce velocity
- Are there water storage container in the kingdom?
- Measure depth and width of river and velocity across the cross-section – to find flow of water
- Checking ground water level
- Finding the depth of river upstream and downstream of the kingdom
- Another river in 'N' kingdom – so less water drawn from river 'R'
- Float objects – see how many goes to 'N' and 'S'
- Build dam – and let use half the water
- Type of soil – soil type may be different in 'N' and 'S'
- Use a fan – measure its RPM

- Get agricultural land area – measure length and breadth of various fields
- Map all irrigation canals – measure size (length and width) of each canal, Use a fan and measure its RPM, to get velocity of water
- Types of crop grown – consumption of water depends on that – rough idea of which kingdom is utilizing more water. Is this redundant since we have already measured the water in the canal, so usage not important.
- Set up meter quantifying the water taken in each canal – measure the flow rate, similar to discussed above
- More canals upstream or not – assuming canals of same size (and cannot measure flow rate), count the number of canals. Canal size need not be same.
- Use of pump by any kingdom -
- Find flow of river upstream and downstream of the kingdom
- Measure Reynolds number and deduce velocity
- Are there water storage container in the kingdom?
- Measure depth and width of canal and velocity across the cross-section – to find flow of water
- Checking ground water level
- Finding the depth of river upstream and downstream of the kingdom
- Another river in 'N' kingdom – so less water drawn from river 'R'
- Float objects – see how many goes to 'N' and 'S'
- Build dam – and let use half the water
- Type of soil – soil type may be different in 'N' and 'S'
- Ask people to report and then we check their numbers (e.g. field area, number of pumps, etc)

Learnings

- Any problem solution needs measurement!
- Observation play a key role before starting a measurement
- Same problem can have different solutions/ approaches involving different types of measurements
- Ask relevant problems to stakeholders
- Need different measuring techniques and instruments for measuring different scales
- Need to discard insignificant assumptions (e.g. rain/evaporation loss, humidity, etc in the previous example)
- Accuracy of measurement is very important
- Importance of theory should not be underestimated
- Implementing feedback system gives a more accurate and refined solution (message in the chat box!)

Problem 2

- A factory is discharging pollutants into the river. If the discharge is treated before dumping it into the river, the pollutant level would be below a threshold; else not.

- You cannot go inside the factory, and can have access to the river only 100 m downstream of the factory.

- How would you know whether the factory is following the law – treating the discharge before dumping, or not?