A Proposal for Fluid Mechanics Lab

Dr. J. Ramkumar
Department of Mechanical Engineering, Indian Institute of Technology Kanpur
jrkumar@iitk.ac.in, 9451220918
Dr. Amandeep Singh
Research Establishment Officer, Imagineering Laboratory, Indian Institute of Technology Kanpur
adsingh@iitk.ac.in, 8847238030
Prof. Kantesh Balani
Department of Material Science and Engineering, Indian Institute of Technology, Kanpur
kbalani@iitk.ac.in, 9198228798

I. Objectives of the Virtual Lab

- **To teach the basics of fluid mechanics and flow theories.**
- **The student would develop interest to conduct new experiments in fluid mechanics and machinery.**
- **The user will able to write correct syntax as per his requirements in his programs**

II. List of experiments

1. Determine loss variables for different types of flow in pipe and open channels.
2. Characteristic curves of Pelton wheel.
3. Coefficient of discharge of given Venturi meter.
4. Variable area duct and verifying Bernoulli's energy equation.
5. Conducting experiments and drawing the characteristics curves of Francis turbine.
6. Characteristic curves of Kaplan turbine.
7. Characteristic curves of reciprocating pump.
8. Drawing the characteristic curves of Gear pump.
9. Hydraulic coefficients for flow through an orifice.
10. Friction coefficients for pipes of different diameters

III. Target group of users

- UG (1st Year/ 2nd Year) [highest priority for development]
- UG (3rd Year/ 4th Year) [next higher priority for development]

IV. Mapping of proposed lab with AICTE courses as per attached list of potential labs

- Fluid Mechanics and Fluid Machines, PCC-ME 203

V. Mapping of proposed lab with universities (minimum 3 universities)

- Dr. A.P.J Abdul Kalam Technical University, KME302, B.Tech: Mechanical Engineering

- Galgotias University, BTME2009 / BTME3024, B.Tech: Mechanical Engineering
- Jadavpur University, ME/T/124 / ME/S/222, B.Tech: Mechanical Engineering
- Shri Mata Vaishno Devi University, MEL2231 / MEL2232, B.Tech: Mechanical Engineering
- Lovely Professional University, MEC217, B.Tech: Mechanical Engineering
- Kalinga University, ME 2021 / ME 2097, B.Tech: Mechanical Engineering
- Kalinga University, CE2101 / CE2192, B.Tech: Mechanical Engineering
- HBTU, ECE-202, B.Tech: Mechanical Engineering
- Nagpur University, BEME303T, B.Tech: Mechanical Engineering
- Punjab University, MEC405, B.Tech: Mechanical Engineering
- Central university of Jharkhand, WEM 211010, B.Tech: Mechanical Engineering
- MATS University, BT341 & BT346, B.Tech: Mechanical Engineering
- VIT, MEE1004 / MEE4006, B.Tech: Mechanical Engineering
- BITS Pilani, F212, B.Tech: Mechanical Engineering

VI. **Expected timelines**

Presentation of proposal to domain experts' committee – 31st March 2022
Demo of First 3 Expts and Review – 30th June 2022
Demo of 5-6 Expts and review – 31st August 2022
Demo of 7-10 Expts and review – 31st October 2022
Final demo of 7-10 Expts – 15th November 2022
Hosting of lab (7-10 Expts) – 30th November 2022

Note 1: The LDC will coordinate the reviews and hosting

Note 2: The lab is supposed to be developed and hosted within 6 - 9 months from the date of approval

VII. **Budget** (Max. Rs 2 Lakhs per experiment with a ceiling of Rs 20 Lakhs per Lab)

Table I. Budget for <Fluid Mechanics Lab>

S. No.	Equipment/Activity	Budget # (In Rupees)
1	Laptop / Machine(computer/laptop)	2.70
2	Manpower(*project engineer/scientist*)	4.80
3	Consumables (various equipment like vernier caliper, screw gauge, stop watch, experimental setup table etc)	4.00
4	Contingency (measurement of sample, mounting sample in machine, repair, incidentals, miscellaneous, etc)	4.00
5	Honorarium for Lab Developer (Rs 20k per experiment; Ceiling of Rs 2 Lakhs per lab)	2.50
6	Miscellaneous	2.00
TOTAL		20 **Lakhs**

To be released based on the recommendation of the review committee
Note: Institute overheads not to be included in the budget

VIII. **Justification of the budget requirements**

(a) Details of Laptop/Machine
A laptop/computer will be required for data-keeping.

(a) Details of Manpower (number, cost per man-months etc.): 10 lakh
i. Total man-months required :
ii. 1 project staff
iii. No. of project staff, cost per man-months

- Three staff including Project Engineer and Project Associate, and as per IIT Kanpur recruitment rules in the link: https://web.iitk.ac.in/july14dordn/data/int_file/Office_Order/1714.pdf
- Cost per man-month: 7.2 lakh

a. Honoraria for other staff associated with the project

Honoraria for Faculty developing the Virtual Lab: (A maximum of Rs. 2 lakhs honorarium for the developers & Rs. 25k for reviews)
Honoraria for Other staff associated with the project
Rs. 25k honorarium for the associated staff

(b) Details of Consumables : 2.5 Lakh
- Stationary – 1 lakh
- Plugins – 0.5 lakh
- Graphic cards – 1 lakh

(c) Details of Miscellaneous cost: 1.2 Lakh
i. Internal Review (Optional, Rs 1000 per experiment)
ii. Field Trials: Travel 1.2 Lakh
iii. Others - N.A.-

IX. **Student Feedback and Learning**
1. How will you collect feedback and use them?
    i. We will collect feedback through feedback (online/offline) form and workshops

2. What is the actual learning component provided by the Virtual Lab?
    i. To teach the basics of fluid mechanics and flow theories.

ii. The student would develop interest to conduct new experiments in fluid mechanics and machinery.
iii. The user will able to write correct syntax as per his requirements in his programs

3. After the Virtual Lab experience, would the student be able to perform the experiment in the real lab?

Yes, after the Virtual Lab experience, the student will have confidence to perform the experiment hands-on in the real lab

ANNEXURE-I

Important information for the development of Virtual Labs

(A Virtual Lab consists of 7-10 experiments)

X. **Link to some sample virtual labs**

https://python-iitk.vlabs.ac.in/ https://cs-iitd.vlabs.ac.in/ https://plchla-coep.vlabs.ac.in/

XI. **Technology Used**

1. We will use HTML, CSS and Java Script for front-end design (free and open source)
2. For Back-end we will use JSON (Free and open-source Software), animation/simulation GUI

XII. **Required Components for virtual experiments**

- Similar steps as provided in the physical lab will be drafted for the Fluid mechanics virtual lab
- Online manual with aim/objective and underlying theory
- At least 5 Pre-test questions will be drafted to check the pre requisite knowledge of student
- An interactive simulator imitating the steps of a physical lab
- At least 5 Post-test questions will be drafted to check the student's understanding after using virtual lab
- Related resources(web and NPTEL Lectures)
- Additional help