

A Proposal for
Sample Preparation and Metallography Lab
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I. Objectives of the Virtual Lab

Metallographic sample preparation, microstructural imaging and quantification applied to structural engineering materials

II. List of experiments

A. Components of Microscope

1. Construct of Microscope and its components

B. Sample Preparation:

2. Sectioning, Mounting, and Grinding and Surface Preparation
3. Technique for Polishing and Etching of Materials (including Electropolishing, tint etching etc.)

C. Metallography – Imaging and quantification

4. Microscopy: Modes, magnification, and imaging with special contrast techniques like DIC, polarized light etc.
5. Stereological principles and digital image processing and analysis
6. Microstructure of Various Steels (hypoeutectoid, eutectoid and hypereutectoid)
7. Microstructure of Various Cast Irons and quantification
8. Microstructure of common metallic materials(Cu, Al, Ti and brass, etc)
9. Tailoring Microstructure with various heat treatments (annealing, normalizing, and quenching)
10. Quantitative techniques for Grain size measurement (ASTM standard, linear intercept, Jeffries method etc).

*Alternatively, 3-4 additional experiments (minimum) may be developed to augment existing labs (www.vlab.co.in).

Note: Please list all related experiments available on the web (vlab.co.in) and compare your proposed experiments with them. Please justify why the proposed experiments are needed and exactly what gaps they fill.

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

- Metallography Laboratory PCC-MM207

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

- Jawaharlal Nehru Technological University Hyderabad; PCC; B. Tech : Physical Metallurgy
- Andhra University; IMT 27; B. Tech : Physical Metallurgy Lab

- Orissa School of Mining Engineering, Keonjhar; BSS; Diploma in Metallurgical Engineering
- VNIT Nagpur; MMP 210; B.Tech: Engineering Physical Metallurgy Lab

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 <Sample Preparation and Metallography Lab>

S. No.	Equipment/Activity	Budget # (In Lakh Rupees)
1	Hardware, software and other equipment (Microscope with imaging facility and dedicated laptop/computer)	4.50
2	Manpower (<i>project engineer/scientist</i>)	4.80
3	Consumables (various materials (metals), sectioning blades, material for mounting, grinding, & polishing, chemicals/etchants, incidentals, miscellaneous)	3.20
4	Contingency (maintenance/repair of hydraulic press, oven, furnaces, incubator, spark plasma sintering unit, vacuum pumps, other instruments, sensor, detectors, etc)	3.00
5	User testing charges (machining, melting, user testing charges, phase-, microstructural-, surface- characterization/treatment)	2.00
6	Miscellaneous	2.50
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

Will require a dedicated microscope (with imaging capability) for metallography observations. If required, a grinding/polishing wheel may also be needed. In addition, an associated laptop/computer will be required for data-keeping. Further, sample preparation may require tumbling mill, jars for ball mill and furnace.

(b) Details of Manpower (number, cost per man-months etc.)

- i. Total man-months required
1 project staff
- ii. No. of project staff, cost per man-months
1 project engineer/scientist (~Rs. 40k per month).
- iii. 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

(c) Details of Consumables

Procurement of various materials (mainly metals) for sample preparation, sectioning blades/saw, and mounting consumables, grinding papers, polishing material, chemicals/etchants, machining, heat treatment, incidentals, etc

(d) Details of Miscellaneous cost

- i. Internal Review (Optional, Rs 1000 per experiment)
- ii. Field Trials - N.A.-
- iii. Others User testing charges for material characterization (microscopy characterization, phase evaluation, surface characterization/treatment, etc)

IX. Student Feedback and Learning

- How will you collect feedback and use them?
 - i. We will collect feedback through feedback (online/offline) form and workshops
 - ii. There is also an associated email id for providing feedback
 - iii. An expansion or additional explanation will be added if the need arises.
- What is the actual learning component provided by the Virtual Lab?
 - i. Learning is through 'pre-test' and 'post-test' along with schematics, strong theory and simulations
 - ii. The simulations and prompts will help the user appreciate and understand the material preparation and metallography technique
 - iii. The microstructure of various materials will also be presented and help the user
- 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 be fully equipped to perform the experiments hands-on in the real lab effectively with full confidence.

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

- We will use HTML, CSS and Java Script (open source software) for front-end design
- For Back-end we will use JSON (open source software)

XII. Required Components for virtual experiments

- Step by step procedure for metallography of samples
- Online manual with aim/objective and underlying theory
- Pre-test for understanding current status of user
- Simulator for assisting the learning on sample preparation
- Post-test for observing learning outcome after learning through virtual lab
- Related resources (web & NPTEL lectures)
- Additional help/feedback