



## **EPSNA-Research Experience for Undergraduates (REU) program**

### **...transition from consuming to creating knowledge...**

The Ethiopian Physics Society in North America (EPSNA) has embarked on a new initiative directed towards promoting research experience for undergraduate students in Ethiopian universities. The program is called Research Experience for Undergraduates (REU). The primary objective of the REU program is to give talented undergraduate students the opportunity to engage in research activities in their field of study during summer break. To implement this on the ground, EPSNA collaborates with research-active professors from various universities in Ethiopia to employ talented undergraduate students to work in their laboratories or computational facilities. EPSNA compensates the students for their work by paying stipends and providing limited funds to buy materials needed for their research project or build prototypes. You may find the details [here](#).

### **Key features of the REU program**

- Research active professors in Ethiopia employ talented students to work in their laboratories or computational facilities
- Students will gain practical experience to do research, create knowledge, and solve real problems
- Program length can be 2-3 months
- EPSNA provides students a stipend to cover their living expenses
- EPSNA also provides limited funds for the procurement of materials needed to conduct research or build prototypes

### **REU participants of 2021**

From July-December 2021, seven talented undergraduate students from Addis Ababa University, Jimma University, Haramaya University, and Bahir Dar University participated in the REU program with five faculty members at these institutions. Six of the students will finish their project by mid-October 2021 and they will present their projects via zoom conferences on 02 October 2021 between 5:00 PM and 6:30 PM, Ethiopian time. The presentation will be broadcasted on the EPSNA website.



## Student's Presentation Schedule

Saturday, October 2, 2021	
5:00 PM-5:10 PM	<b>Welcome note</b> , Dr. Dereje Seifu, EPSNA president
5:11 PM-5:23 PM	<b>Thermal and Optical Properties of Zinc Oxide</b> , Chala Bedada
5:24 PM-5:36 PM	<b>Experimental Evaluation of Forced Draft Gasifier Stove</b> , Yohannes Haile
5:37 PM-5:49 PM	<b>Assessment of Solar Energy Potential in Eastern Harerghe: The Case Study of Haramaya Wereda, Ethiopia</b> , Shamil Kasim
5:50 PM-6:10 PM	<b>Mobile medical waste incinerator with energy recovery system</b> , Abel Wondwosen, Amanuel Girma, Yohannes Ayalew
6:11 PM-6:30 PM	<b>Feedback, comments, and/or suggestions from the REU participants</b>

**P.S: All hours are in Ethiopia local time**

## Project titles and Abstracts

### **Thermal and Optical Properties of Zinc Oxide**

Chala Bedada and Nebiyu Gemechu

Department of Physics, Jimma University

**Abstract:** Zinc oxide (ZnO) is an inorganic compound with a wide-bandgap semiconductor and has many applications in optoelectronic devices (photodiodes, solar cells, phototransistor, photomultipliers, and laser diodes), ceramics, catalysts, pigments, etc. It is a material with a great variety of properties including high heat capacity, thermal conductivity, and temperature stability. In this research work, the thermal and optical properties of commercially obtained ZnO nanopowder have been investigated. The thermal properties were studied using a calorimeter and heating powder method whereas its optical properties were investigated using a UV-Visible spectrometer. The finding of the study revealed that its specific heat capacity and thermal conductivity are  $0.522 \text{ J(g}^\circ\text{C)}^{-1}$  and  $21.01 \text{ WK}^{-1}\text{m}^{-1}$ , respectively. Moreover, the UV-Vis spectrum shows that its maximum optical band absorption (1.4028) is located at 376 nm. Finally, using



Tauc's method, the optical bandgap of the investigated ZnO nanopowder is found to be 3.13eV.

### **Experimental Evaluation of Forced Draft Gasifier Stove**

Yohannes Haile and Kamil Dino

Department of Mechanical and Industrial Engineering, Addis Ababa University

**Abstract:** The number of households using three-stone fire for cooking is extremely large in developing countries such as Ethiopia. To reduce the indoor air pollution load associated with cooking in using three-stone fire needs to be reduced as much as possible. There is a natural draft gasifier stove designed, manufactured, and tested at the institute. In order to improve the performance of the gasifier stove, a fan is introduced to supply forced air. This work is part of the improvement of the gasifier stove using a computer fan to improve the performance. In the presentation, the improvement in the design and preliminary test results will be presented as an outcome of this project.

### **Assessment of Solar Energy Potential in Eastern Harerghe: The Case Study of Haramaya Wereda, Ethiopia**

Shamil Kasim and Haftu Brhane

Department of Physics, Haramaya University

**Abstract:** Solar energy is promoted as a sustainable energy supply technology because of the renewable nature of solar radiation and the ability of solar energy conversion systems to generate greenhouse gas-free electricity during their lifetime. In this study, we examine solar energy potential of Haramaya Wereda, Eastern Harerghe, Ethiopia for the period of 2018-2020 gridded daily and one month observed data of one meteorological station. To find the annual trends, Mann-Kendall and Sen's slope estimator were used. The monthly mean daily global solar radiation and fraction of sunshine hours have been employed in this study to estimate global solar radiation and satellite data source were used for comparison of the estimated global solar radiation. The study found that the mean annually estimated global solar radiation over Haramaya is 6.6.23KWH/m<sup>2</sup>day. The result of this study could be applicable for the stakeholders in the Wereda.

### **Mobile medical waste incinerator with energy recovery system**

Abel Wondwosen, Amanuel Girma, Yohannes Ayalew, and Haileluoul Sahle

Department of Mechanical and Industrial Engineering, Addis Ababa University



**Abstract:** Bringing a long-term solution for a hazardous waste management system that is efficient, economical and friendly to the environment is very challenging. Especially when the waste is hazardous and contagious like medical waste, it is vital and imperative. Such problems will be tripled in developing countries since the existing waste management system is very poor. This project aims at developing an innovative combustion system for medical waste especially coming from medical centers, health centers administered by governmental or private. A reliable data collection was collected from the main stakeholders, product specification was set and detailed design and prototype development was done. Following a derivative product design and development approach, a smart model is developed that could effectively manage treating the hazardous waste, energy as a form of hot water will be produced, and the contagious effect of medical waste will be reduced.

## **Brief Biography of REU21 Participants**

### **Student: Chala Bedada|Supervisor: Dr. Nebiyu Gemechu**

Mr. Chala Bedada has been an undergraduate physics student at Jimma University for the last four years. He has recently graduated by completing his study with a CGPA of 3.9, standing first from his batch. Mr. Chala is a highly motivated student in exploring new knowledge and experience. He is also an excellent student in tackling the challenges in researching. Chala was supervised by Nebiyu Gemechu (Ph.D.), an associate professor of condensed matter physics at Jimma University. Dr. Gemechu is actively engaged in the supervision of postgraduate students and is currently a chairman of the department of physics at Jimma University. His research interests include defect analysis in solids using luminescence method, thermoluminescence dosimetry, materials physics, and nanomaterials.

### **Student: Yohannes Haile|Supervisor: Dr. Kamil Dino**

Yohannes is a final year Mechanical Engineering student who has specialized in Thermal Engineering. He is enthusiastic about making things happen based on theoretical observation. He is currently working not only on this project but also on other projects which are more practical and problem-solving for the country. Yohannes is monitored by Dr. Kamil Dino, who is currently working at Addis Ababa Institute of Technology in Thermal Engineering Stream. Both are focused on improving the



livelihood of the rural poor who are cooking food using three-stone fire. They are planning to come up with a clean cooking solution.

**Student: Shamil Kasim|Supervisor: Mr. Haftu Brhane**

Shamil Kasim was born in Oromia region, Arsi zone, Sude woreda, in a village called Getara and grew up around this area by playing with children of his neighbor and when his age is suit for education, he started his education at Getara Gurracha elementary school and completed it at this school by taking regional exam. He scored 99.97 percentile and he got a chance to compete to join Oda Development Association (ODA)boarding school, but he could not succeed with it. However; he joined secondary education at Kulla secondary school and completed secondary education by scoring 3.85 grade 10th national exam and he continued to attend preparatory education at Kulla preparatory school. After he passed the entrance exam, he joined Haramaya University, college of natural and computational science, Physics department. He has started his education through attending the class and by attending the class he cover 90% of his studying. Because of his giving due attention to what the lecturer cover in the class, he scored a better GPA 3.97 and this is top score(CGPA) from his department and he is moving on with this score. Over all, Shamil is more experienced and potential full student in all directions with full confidence in all things he did, he does, he will do. Shamil was supervised by Haftu Brhane, who is a Physics instructor and researcher who teaches Environmental Physics and others at Haramaya University, Department of Physics. In addition to teaching the Environmental Physics course and doing research in the University, he served as chairman of the Ethiopian space science society Harar branch. Haftu holds a BEd in Physics, MSc in Quantum Physics, and Assistant Professor in Environmental Physics starting 2018 and is now PhD candidate in Environmental Physics (Environmental Hydrology) at Haramaya University. Currently, Haftu is doing research on Climate change impacts on Agriculture and Hydrology, Environmental Sciences, GIS and Remote Sensing, Environmental and Hydrological Modeling and Drought Characterization.

**Students: Abel Wondwosen, Amanuel Girma, and Yohannes Ayalew|Supervisor: Dr. Haileluoul Sahle**

Three undergraduate students from the School of Mechanical and Industrial Engineering, including Abel Wondwosen, Amanuel Girma, and Yohannes Ayalew teamed up for their undergraduate project work. Their field of study is in mechanical engineering focusing on Thermal and Motor Vehicle. They were mentored by Haileleoul Sahle (Ph.D.). Dr. Sahle has finished his undergraduate study in Mechanical



---

Engineering from Bahir Dar Institute of Technology and specialized in Applied Mechanics from the Mechanical Engineering Department of Addis Ababa Institute of Technology. His Ph.D. research was on a new technique for optimization of an energy absorption system that could be deployed in many mechanical products; vehicles, aircraft, helmets, to maximize their crashworthiness. He has been working in Bahir Dar and Addis Ababa universities for a total of 17 years and works as a supervisor and consultant for non-governmental and governmental assignments and projects. His specialization in teaching and advising is related to product design and development, and Mechanics of Material.