



**UNIVERSITY
SCHOLAR
CONFERENCE**

UNIVERSITY SCHOLAR CONFERENCE: ENGINEERING AND INNOVATION (USC 2022)

WOMEN'S EMPOWERMENT IN ENGINEERING

Association of Mechanical
Engineering Students (AMES)

Department of Mechanical
Engineering (DoME)

Kathmandu University,
Dhulikhel, Nepal

May 17-18, 2022



HOST



CO-HOST



ORGANIZER



SUPPORTING PARTNERS



ABOUT AMES

Established in 2002 A.D., Association of Mechanical Engineering Students (AMES) is a student wing of Mechanical Engineering students that provides platform to delve into the practical side of the contextual matters and involves the students in various co-curricular and extra curricular activities through various programs. The club is moderated by the department and conducts different programs as per the academic calendar in response to the department.

AMES conducts various activities collaborating with other clubs within the university and engineering associations outside the university. AMES also collaborates with different governmental and non- governmental agencies to organize awareness and advocacy programs.

AMES occasionally organizes software trainings, welcome-farewell, mechanical cup, indoor games, interaction programs.

Cordinated by Dr. Surendra Sujakhu (Assistant professor), Acting as a bridge between the students and the facilitators, our aim is to develop sufficient technical and leadership skills to the students and provide them a platform to showcase their talent while making free access to study resources. AMES has a vision to create accessible opportunities for personal and professional growth of individuals and make an impact in the community.



EXECUTIVE COMMITTEE 2021/22

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Facilitator / Coordinator

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President, AMES

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Mr. Saras Mainali
Executive Member

Ms. Shrija Shrestha
Executive Member

Mr. Sugam Karki
Executive Member



ABOUT USC

University Scholar Conference: Engineering and Innovation (USC 2022) is a university student level conference going to be organized by the Association of Mechanical Engineering Students (AMES) at Kathmandu University on 17th May 2022, cohosted by Himalayan University Consortium, ICIMOD, and Supported by Department of Mechanical Engineering (DoME), Society of Mechanical Engineers Nepal (SOMEN) and Society of Mechanical Engineering Students (SOMES).

USC 2022 provides a scholarly platform for graduate and undergraduate students to exchange and share cutting-edge development and state-of-the-art research work in the field of science and engineering among academia, researchers, industrialists, professors, students, and policymakers. The conference committee highly encourages the participation of university students engaged in engineering and science education within Nepal and abroad.

The Conference Board encourages you to participate, share the information and invite colleagues to participate in the conference and submit the research work for the conference Call for Papers. Approved full papers will be peer-reviewed and evaluated based on originality, technical and/or research depth, accuracy, and relevance to the conference theme and topics before publishing in **KUSET and Institute Of Physics (IOP) - Materials Science and Engineering**.

The theme for this year's conference is Engineering and Innovation – Automobile System, Material and Design for Transformation, Advances in Energy Systems and Emerging Technologies and Digitalization and Emerging Technology. We firmly believe that innovation has the potential to add great value to many things which is why it plays such an important role in engineering.

The Conference Chair for the University Scholar Conference, 2022 is Prof. Dr. Bim Prasad Shrestha. During his 17 years at Kathmandu University, he has bagged several grants, published research and conference and peer-reviewed papers, and accomplished numerous research projects. His research areas are diverse covering automation, agriculture and rural development focusing on biofuels and biomass in energy sector, machine vision, sanitation etc. Our keynote speaker for the event is Dr. David Molden, Director-General of the International Center for Integrated Mountain Development (ICIMOD), an intergovernmental knowledge organization dedicated to research and practical training in the field of protection of mountains, their natural resources and people from the Himalayan region of the Hindu Kush (HKH). His leadership has been instrumental in positioning ICIMOD as a regional organization that works within and in eight countries in fields such as climate change, adaptation and resilience building, ecosystem management, cryosphere, air pollution and management. of water resources.

The organizing committee consists of seven different chairs and a total of 15 members working actively under the supervision of the Conference Secretary, Mr. Pawan Sapkota. With a record number of participants expected this year, we are delighted to see that this conference is being more substantial with each year passing. We are excited about the record number of sessions, and wide variety of ideas that scholars and practitioners will bring into our fold.

The Organizing Committee
USC 2022

WELCOME NOTE BY : CONFERENCE CHAIR

As the conference chair, I cordially welcome you to the 2nd conference of USC organized by the Association of Mechanical Engineering Students (AMES) at Kathmandu University. With a record number of participants expected this year, we are delighted to see that this conference is being more substantial with each year passing. I am equally excited about the record number of sessions, and the wide variety of ideas that scholars and practitioners will bring into our fold.



Prof. Dr. Bim Prasad Shrestha
*Conference Chair, University Scholar
Conference 2022*

The theme for this year's conference is Engineering and Innovation. We firmly believe that innovation has the potential to add great value to many things which is why it plays such an important pivotal role in Engineering education and its implementation. I truly hope that this conference will allow the participants a productive discourse not only in innovation but also in fields that reflect the real-world applications of engineering. I am also particularly excited about the upcoming presentation from our keynote speaker, Dr. David Molden, former Director-General of the International Center for Integrated Mountain Development (ICIMOD), an intergovernmental knowledge organization dedicated to research and knowledge implementation in the Hind Kush Himalayan region.

The conference is made possible by the tireless dedication of members who, through service on the Conference Organizing Committee, generously gave their time, aptitude, and perception to produce an event meant to deliver beyond expectations. Under their leadership, volunteerism has risen to new levels within the organizing committee. This conference would not be possible without their generous help. I am truly grateful to the Conference Secretary, Mr. Pawan Sapkota, and all the other chairs for the time, energy, and thought they have invested in organizing the event.

I am thankful for the conference organizing committee members, the track chairs, the session chairs, and the numerous volunteers, without their generous contributions this conference would not have set another new record number of presentations and participants.

We also appreciate the values added by our supporting partners as the Department of Mechanical Engineering (DoME), Himalayan University Consortium (HUC), ICIMOD, Nepal Technology Innovation Center (NTIC), Green Hydrogen Lab (GHL), Institute of Engineering (IOE), Nepal Astronomical Society (NASO), Women of Aeronautics & Astronautics Nepal (WoAA), Girls In Tech, Nepalese Society of Agricultural Engineers (NSAE), Society of Mechanical Engineer's Nepal (SOMEN), Society of Mechanical Engineering Students (SOMES), Automobile and Mechanical Engineering Students' Innovative Nexus (AMESIN), Society of Innovative Mechanical Engineering Students (SIMES), and Tekka.

Most of all, I thank you, the participants, for enriching this conference with your presence. I hope you will enjoy the content, renew old friendships, make new friends, get new ideas, and most importantly, have a great time.

WELCOME NOTE BY : CONFERENCE SECRETARY

Dear Delegates,
Warm Greetings!!!

Last year, with an intention to build a culture of research among the undergraduates, University Scholar Conference was initiated. It got outstanding response from students, academics, and researchers of Kathmandu University.

With the goal to amplify the results of the previous year and to take the conference to an international level, me and my team cordially welcome you to the second edition of the University Scholar Conference: Engineering & Innovation'22. This year, we have engulfed our conference with the theme of "Women Empowerment in Engineering". It is an attempt to present efforts of female academics and to work as a platform to empower women in the field of STEM.

A few months ago, when I was entrusted with the task of Conference Secretary, I was very thrilled & excited. But down the road, I've faced many hurdles & problems within myself. However, with the support of my colleagues & advisors, I was able to sail through this journey and I am hopeful that me and my team will be able to meet the expectations of our esteemed guests.

Talking about the event, the plenary session covers a wide spectrum of topics ranging from orations, keynote sessions along with special remarks by the Secretary of Ministry of Science & Technology. The session also includes a presentation and an interaction session on project GridVile by correspondents from Norwegian University of Science and Technology (NTNU). After this, technical sessions along with poster session will be conducted.

Now I would like to express my deepest gratitude to our conference chair, Prof. Dr. Bim Prasad Shrestha, for his commitment, hard work, and vision in leading this conference. I would also like to thank our beloved Advisory faculty of the University Scholar Conference for their immense support and guidance in each & every step of organizing this conference.

Subsequently, I would like to express my gratitude to the organizing committee for working really hard despite academic pressure. I am very thankful to them for this fruitful journey at USC.

Finally, I would also like to thank the Department of Mechanical Engineering (DoME), Himalayan University Consortium, ICIMOD, Nepal Technology Innovation Center (NTIC), Green Hydrogen Lab (GHL), Institute of Engineering (IOE), Nepal Astronomical Society (NASO), Girls in Tech, Tekka, Women of Aeronautics & Astronautics Nepal (WoAA), Society of Innovative Mechanical Engineering Students (SIMES), Society of Mechanical Engineering Students (SOMES), Society of Mechanical Engineer's Nepal (SOMEN), Nepalese Society of Agricultural Engineers (NSAE), Society of Mechanical Engineering Students (SOMES), ERC for your contribution & active involvement in the conference, & I hope for your support in near future.

From my personal experience, USC has brought a tremendous positive impact on my career development & a long-term friendship with the students & faculty of the Department of Mechanical Engineering. It has brought a huge positive impact on both my professional and personal life, and I am grateful that I have had a chance to be a part of this wonderful journey.

I thank each and every one of you who are contributing to the success of the conference.



Mr.Pawan Sapkota

*Conference Secretary, University Scholar
Conference 2022*

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Mr. Malesh Shah, *Kathmandu University*
Mr. Chiranjeevi Mahat, *Kathmandu University*
Mr. Jahir Ahmed Jibrán, *Kathmandu University*
Mr. Pawan Karki, *Kathmandu University*
Mr. Bijendra Shrestha, *Kathmandu University*
Mr. Nischal Chaulagain, *Kathmandu University*
Mr. Uren Amatya, *Kathmandu University*
Ms. Sirapa Shrestha, *Kathmandu University*

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Conference Secretary

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Executive Member, AMES

Mr. Sangam Bhandari
Executive Member, AMES

MESSAGE FROM COORDINATOR

As a coordinator, I warmly welcome you to the 2nd edition of University Scholar Conference (USC 2022) organized by the Association of Mechanical Engineering Students (AMES). USC is a university student-level conference which is one of its kind in Nepal as well as in this region of the world. USC was initiated in 2021 with the main goals to promote quality research and project from undergraduate level, and to motivate students towards sharing and publishing their project and research outcomes. As society becomes ever more dependent on engineering and innovation, the themes and topics being considered at the conference continue to become more relevant and important.

I am confident that your participation in USC 2022 conference will be productive and meaningful investment of your time and effort to learn and share your research and project. It is an opportunity for everyone to network academia, researchers, industrialists, professors, students and policy makers to gain knowledge in trending research works. I am convinced that your presence in the event will make great experience to all. I wish you will have a very fruitful and networking conference session.

As a conference coordinator, I am grateful to be a part of such a hard-working team. The conference is made possible by the tireless dedication of members who generously gave their time, energy and perception to produce an event meant to deliver beyond expectations and thoughts. Each of them has made a very large contribution to the fine quality of this technical program. My appreciation for the support provided by all the Faculties, Department of mechanical engineering, School of engineering, Student welfare directorate, Green hydrogen lab and all other research teams. For the current executive team, the sub-committees, I cannot express my pride for these people in words.

I add my best wishes for a successful and fruitful conference and my thanks to all organizers.

I will see you soon in Kathmandu University and ICIMOD!



Assist. Prof. Dr. Surendra Sujakhu
Coordinator/ Facilitator, AMES

INVITED SPEAKERS



HONORABLE ER. GANESH SHAH

Er. Mr. Ganesh Shah is a former Minister for Environment, Science, and Technology. Mr. Shah is a Mechanical Engineer by profession and received his M-Tech (Technical Engineering) from Patrice Lumumba Peoples' Friendship University in 1973. Shah was appointed the Minister for Environment, Science, and Technology when the cabinet was extended. Mr. Shah is a big advocate of the climate change issues in Nepal and has been quoted in various media outlets during his time as a minister.

HONORABLE PRAMILA DEVI BAJRACHARYA

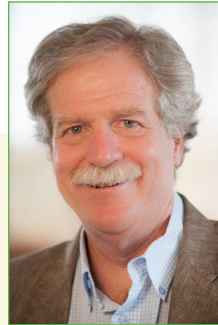
Er. Ms. Pramila devi Bajracharya is the current secretary of Ministry of Science and Technology. She received her Master of Science in Environmental Sanitation , Natural Systems for Waste Water Treatment from Ghent University in the year 2006 AD. She is an engineer by profession and has worked as an esteemed member for 7 government departments till date. She has been an advocate for proper government policies in the field of waste management , sanitation and adaption of EVs.



KEYNOTE SPEAKER

DR. DAVID MOLDEN

Former Director General of the International Center for Integrated Mountain Development (ICIMOD), had led different programmes of knowledge into action across the eight countries of the Hindu-Kush Himalaya. Throughout his tenure he promoted trans-boundary cooperation across countries using Science Diplomacy. Being a Previous Acting Director General, and Deputy Director General for Research for the International Water Management Institute (IWMI), he led the acclaimed Comprehensive Assessment of Water Management in Agriculture, involving over one thousand researchers and practitioners from hundreds of institutes to answer the question how water can be developed and managed to reduce poverty and support ecosystems. Contributing to concepts of water scarcity, water productivity, water accounting, transboundary water management he has a very decent ability to integrate social, technical and environmental aspects of natural resources management, which can promote interdisciplinary and cross-cultural teamwork. Moreover, he is also an alumni of one of the renowned universities, Colorado State University with Ph.D. in Specialty in groundwater and irrigation and MSc., majoring in groundwater hydrology. With his competency and expertise, of linking science with policy and practice he had delivered key messages to broad audiences with several keynote speeches, media interview and opinion pieces across Asia and Africa.



2022

UNIVERSITY SCHOLAR
SCHEDULE

CONFERENCE SCHEDULE

FIRST DAY

17 May 2022
9:00 - 16:30

VENUE:

ICIMOD

Khumaltar.

Lalitpur

REGISTRATION/ TEA/ COFFEE TALK

9:00 - 9:30

INAUGURATION CEREMONY

- Overview of USC
- Opening remarks by Dr. Pema Gyamtsho, Director General ICIMOD
- Welcome remarks by Prof. Dr. Bhola Thapa, VC, Kathmandu University

9:30 - 10:00

PLENARY SESSION

- Welcome remarks by Prof. Dr. Bim Prasad Shrestha, Conference Chair
- Keynote session by Dr. David Molden
- Remarks by Pramila Devi Bajracharya, Secretary, Ministry of Science and Technology
- Short Presentation on GridVile.
 - Student-Led Innovation for Clean & Accessible Energy
 - Usman Zarar, Project Manager | GridVile,
 - Charlotte Corapi, MEng Mechanical engineering student at NTNU
- Brief Interaction Session with NTNU-Norway in Hydropower Solar and Other Energy Related Topics.
- Closing Remarks by Prof. Dr. Tri Ratna Bajracharya, HUC Steering Committee Member

10:00-11,30

LUNCH / GROUP PHOTO

11:30 - 12,30

REMAINING SESSIONS AT KU

12:30 - Remaining Time

SECOND DAY

18 May 2022
9:00-16:30

VENUE:

Kathmandu University

Dhulikhel

REGISTRATION AND TEA RECEPTION

9:00 - 9:30

PARALLEL TECHNICAL SESSIONS

9:30 - 11:00

LUNCH BREAK AND POSTER SESSION

11:30 - 12:30

PARALLEL TECHNICAL SESSIONS

12:30 - 14:00

TEA BREAK

14:00 - 14:30

CLOSING CEREMONY

- Remarks by Distinguished Delegates
- Certificate, Award and Prize Distribution
- Remarks by Guests
- Remark and Closing by Conference Chair
- Remarks and Closing by Conference Secretary

14:30 - 16:30



UNIVERSITY SCHOLAR CONFERENCE

[HTTP://IAMES.ICU.EDU.NP/USC2022/](http://iames.icu.edu.np/usc2022/)

USC 2022: ENGINEERING AND
INNOVATION (USC). 2ND EDITION

EMAIL: USC@KU.EOU.NP | IAMES@KU.EDU.NP

CONFERENCE EVENTS

Session Title: Digitalization and Emerging Systems [Virtual]

Session Chair: Dr. Milan Poudel (milan002@e.ntu.edu.sg)

Date: 17 May 2022

Time: 1:40 to 3:00 PM

Venue: Mini Auditorium, KU (Zoom:)

Time	Topic	Authors
1:40 – 2:00 PM	To investigate thermal conductivity of phase change material by incorporating surfactants	Qaiser Azim*, Dr. Shahid Mehmood
2:00 – 2:20 PM	Optimization of design and operational parameters of bio-sand filter using response surface methodology	Sushil Dhungana*, Simon Kumar Shrestha, Sailesh Chitrakar, Hari Prasad Neopane.
2:20 – 2:40 PM	Numerical analysis of erosion and erosion induced vibrations in Francis turbine	Rakish Shrestha, S.S. Pradhan, P. Gurung, A. Ghimire, S. Chitrakar*
2:40 – 3:00 PM	Smart dustbin	Rohit Bhusal*, Phurba Tshering Sherpa, Avisek Kumar Sah, Sujan Poudel, Shubham Niroula

Session Title: Material and Design for Transformation [Virtual]

Session Chair: Dr. Anil Kumar Bastola

Date: 17 May 2022

Time: 1:40 – 3:00 PM

Venue: Executive Dining Hall, KU (Zoom)

Time	Topic	Authors
1:40 – 2:00 PM	Design, fabrication and performance evaluation of adjustable mechanical fruit and vegetable grader	Shreeya Shrestha*, Anjana Chaulagain, Bishwa Bandhu Rokka, Bikash Neupane, Sandesh Karki Er, Ankit Shrestha
2:00 – 2:20 PM	Comparative structural and thermal analysis of metals for vented rotor disc application	Arpan Koirala*, Dr. Sailesh Chitrakar
2:20 – 2:40 PM	Investigation on effect of post processing techniques of FDM based 3d printed parts on its mechanical strength	Arjun Kumal, Rohit Kumar Ray, Anuja Shrestha, Pratisthit Lal Shrestha, Abishek Kafle, Raman Silwal
2:40 – 3:00 PM	A review on micro-district: It's implication on transportation system	Raghav Sharma, Abishek Ghimire, Sangam Bhandari, Malesh Shah*, Ashok Sapkota

Session Title: Automotive System [Virtual]**Session Chair: Dr. Prabij Joshi****Date: 17 May 2022****Time: 1:40 – 3:00 PM****Venue: Senate Hall, KU (Zoom)**

Time	Topic	Authors
1:40 – 2:00 PM	Design of steering and braking system of an electric all-terrain vehicle	Susmita Parajuli*, Prakash Koirala, Rahul Jamkatel, Gagan Acharya, Subin Tandukar
2:00 – 2:20 PM	Static Test Pad for Solid Rocket Motors	Svanik Garg
2:20 – 2:40 PM	Design, Modeling, and Simulation of Power Train of an Electric All-Terrain Vehicle	Prakash Koirala*, Gagan Acharya, Susmita Parajuli, Subin Tandukar, Rahul Jamkatel
2:40 – 3:00 PM	Heat Transfer Analysis of a Constant Area Straight Rectangular Fins of a Petrol Engine With Different Extended Surface	Aplesh Kumar Mahato*, Dinanath Sharma, Dinesh Tamang, Dipendra Sah

Session Title: Advances in Energy Systems [Virtual]**Session Chair: Dr Bijay Thapa****Date: 17 May 2022****Time: 1:40 – 3:00 PM****Venue: CV Raman Auditorium, KU**

Time	Topic	Authors
1:40 – 2:00 PM	A computational approach for prediction of the critical region of Francis runner blade under varying load conditions	Surakshya Neupane*, Laxmi Parajuli, Sujata Gyawali, Dr. Durga Bastakoti
2:00 – 2:20 PM	Production of fuels by pyrolysis of waste plastic	Saroj Raj Kafle*, Pragati Gaire
2:20 – 2:40 PM	Experimental and numerical analysis of sediment erosion in turgo turbines	Aashutosh Paudyal*, Ajaya K.C., Sujana Adhikari, Sailesh Chitrakar, Aman Kapali
2:40 – 3:00 PM	Prospects of central heating, floor heating and wall heating systems: A review	Raghav Sharma, Abishek Ghimire, Sangam Bhandari, Malesh Shah*, Ashok Sapkota

CONFERENCE EVENTS

Session Title: Digitalization and Emerging Systems [Physical]

Session Chair: Dr. Ranjit Shrestha

Date: 18 May 2022

Time: 9:30 to 10:30 AM

Venue: Executive Dining Hall, KU

Time	Topic	Authors
9:30 – 9:50 AM	Knee flexion/extension angle measurement for gait analysis using machine learning solution "mediapipe pose" and its comparison with kinovea®	Amit Gupta, Prafisthit Lal Shrestha, Magne Jørgensen, Bhola Thapa, Raju Shrestha, Raman Silwal
9:50 – 10:10 AM	Simulation and field based study of thermal performance of a building - A case study	Kamal Gautam*, Yaman Joshi, Malesh Shah
10:10 – 10:30 AM	Simulation of passive thermal retrofitting techniques in earthquake-resistant building community: a case study of buildings in thakle namuna basti, melamchi, nepal	Gaurav Timisina, Malesh Shah*, Dikshant Shrestha, Path Singh Devkota

Session Title: Material and Design for Transformation [Physical]

Session Chair: Dr. Binaya K.C

Date: 18 May 2022

Time: 9:30 to 11:00 AM

Venue: Mini Auditorium, KU

Time	Topic	Authors
9:30 – 9:50 AM	Design of a supersonic nozzle using method of characteristics (MOC) to enhance non-equilibrium flow pressure recovery at the outlet	Nischal Shrestha*, Narayan Guragain, Mridul Neupane, Sudip Bhattarai Ph. D.
9:50 – 10:10 AM	A review on cleaner and safer propellant materials for space vehicles and their characterization	Ashutosh Dev*, Yogesh Dumbre, Alice Rana, Shreela Sapkota, Prasiddha Raut
10:10 – 10:30 AM	Study of tempering heat treatment process in welded mild steel	Balkrishna Chaudhary, Sabal Panthee, Surendra Sujaku*, Dadiram Dahal
10:30 – 10:50 AM	A study on the traditional kol technology of Nepal	Sunil Belbase

Session Title: Automotive System: Electric Vehicle Technology [Physical]**Session Chair: Dr. Bishal Silwal****Date: 18 May 2022****Time: 9:30 – 11:00 AM****Venue: Senate Hall, KU**

Time	Topic	Authors
9:30 – 9:50 AM	Conversion of an IC engine vehicle to a battery-electric vehicle	Biraj Singh Thapa, Ph.D*, Nitesh Kumar Yadav, Biraj Kharel, Abhishek Mishra, Nabin Mishra, Tej Raj Tharu.
9:50 – 10:10 AM	Assessing the performance of a demonstrative hydrogen fuel cell powertrain in the chassis of an internal combustion engine vehicle	Yaju Shrestha, A. Subedi, M. Sapkota, P. Poudel, N. K. Yadav, B. S. Thapa*
10:10 – 10:30 AM	Design and static structural analysis of electric Go-kart chassis	Roshan Ojha*, Ashim Joshi, Sudeel K.C., Raghav Sharma, Ajay Kumar Sah, Sirapa Shrestha
10:30 – 10:50 AM	Failure parameters in battery recycling technologies	Anupama Gaihre*, Abishek Subedi, Bikalpa Chaulagain, Prayush Jung Karki, Strena Shrestha, Sirapa Shrestha

Session Title: Automotive System: Design and Technology [Physical]**Session Chair: Dr. Sailesh Chitrakar****Date: 18 May 2022****Time: 12:30 – 2:00 PM****Venue: Senate Hall, KU**

Time	Topic	Authors
12:30 – 12:50 PM	Modifications in internal combustion engine for performance improvement – A scoping review	Saras Mainali*, Sugam Karki
12:50 – 1:10 PM	Design and analysis of four-wheel steering mechanism	Suman Timsina*, Bivek Baral, Pawan Sapkota, Aashish Dawadi, Nischal Bhusal
1:10 – 1:30 PM	Study and optimization of muffler to reduce backpressure	Prajwol Joshi*, Ramesh Bhandari, Abhishek Ghimire, Anmol sagar Tamrakar, Surendra Sujakhu, Ph.D
1:30 – 1:50 PM	A detailed study on the life cycle of leaf spring in the context of Nepal	Narayan Guragain*, Piyush Nepal, Rodan Bista, Surendra Sujakhu, Ph. D

CONFERENCE EVENTS

Session Title: Advances in Energy Systems: Hydrogen Technologies [Physical]

Session Chair: Biraj Dhungana

Date: 18 May 2022

Time: 9:30 – 11:10 AM

Venue: CV Raman Auditorium, KU

Time	Topic	Authors
9:30 – 9:50 AM	Parametric Design and Optimization of Laboratory Scale Hydrogen Value Chain	Dr.Biraj Singh Thapa*, Abhishek Subedi, Rohit Joshi, Himanshu Giri, Vikram G.C
9:50 – 10:10 AM	Study on green hydrogen compression, storage and dispensing systems for refueling light-duty vehicles	Mridul Bhattarai, Abin Thapa, Sangam Limbu, Shrayad Chapagain, Nitesh Kumar Yadav, Biraj Singh Thapa*
10:10 – 10:30 AM	Assessment for replacing coal and petroleum product with green hydrogen for steel and iron production	Sangam Bhandari, Nashla Shakya, Sabin Bhattarai, Dr.Biraj Singh Thapa*
10:30 – 10:50 AM	Parametric modeling and optimization of alkaline electrolyzer for the production of green hydrogen	Sagar Niroula, Chandan Chaudary, Abhishek Subedi, Biraj Singh Thapa*
10:50 – 11:10 AM	Assessment to replace fossil fuel with green hydrogen in Nepalese industries to decarbonize the economy	S. Acharya, A. Chalise, A. Ghimire, S. Bhattarai, B. S. Thapa*

Session Title: Advances in Energy Systems: Hydropower Technologies [Physical]

Session Chair: Dr. Krishna Prasad Shrestha

Date: 18 May 2022

Time: 12:30 – 2:00 PM

Venue: CV Raman Auditorium, KU

Time	Topic	Authors
12:30 – 12:50 PM	Frequency control of micro-hydro power plant using governor and ELC.	Aayusha Jha*, Aayush Karki, Bidhan Poudel, Dhiraj Mandal
12:50 – 1:10 PM	Numerical investigation of flow behaviour and erosion potential in side-wall clearance between guide vane and runner	Arun Pandey*, Saroj Gautam, Sailesh Chitrakar, Nirmal Acharya, Pawan Lal Bijukchhe
1:10 – 1:30 PM	Computational study of sediment erosion on Francis blades to study impact of impingement angle on erosion rate	Kushal Shrestha*, R. Poudel, S. Shrestha, B. Thapa, S. Chitrakar, Q. Zhongdong, Z. Guo
1:30 – 1:50 PM	Design, FEM analysis and CFD analysis of traditional and hooped Pelton runner	Aaditya Karna*, Sailesh Chitrakar, Mausam Bhurtel, Suman Bishwokarma, Prayash Dahal

Session Title: Advances in Energy Systems: Solar and Battery Technology [Physical]**Session Chair: Dr. Shalendra Kr. Jha****Date: 18 May 2022****Time: 12:30 – 2:00 PM****Venue: Mini Auditorium, KU**

Time	Topic	Authors
12:30 – 12:50 PM	Relative assessment of carbon emission from fossil fuel-based vehicles, battery electric vehicles, and fuel cell electric vehicles.	Chandan Chaudhary, Sagar Niroula, Abhishek Subedi, Biraj Singh Thapa*
12:50 – 1:10 PM	Demonstrative Model of PV based solar water heating and circulating system	Sangam Bhandari, Ashim Katuwal, Atul Pokhrel, Nifesh Raj Gautam, Nischal Bhatta, Mr. Niranjan Bastakoti*
1:10 – 1:30 PM	Status Review of Solar Water Heaters in Nepal	Aakash Mali*, Prajwol Joshi, Prajwal Gautam , Sagar Pandit
1:30 – 1:50 PM	Barrier in recycling of batteries in Nepal	Sirapa Shrestha, Sujit Man Shrestha*, Amrit Kumar Yadav, Kusum Khatiwada

Session Title: Advances in Energy Systems: Energy Systems [Physical]**Session Chair: Nawaraj Sanjel****Date: 18 May 2022****Time: 12:30 – 2:00 PM****Venue: Executive Dining Hall, KU**

Time	Topic	Authors
12:30 – 12:50 PM	Techno-economic analysis of energy systems in thakle namuna basti- A case study	Kshitiz Koirala*, Saugat Upreti, Malesh Shah
12:50 – 1:10 PM	Stove maturity status review	Sunil Belbase*, Prashant Sah, Jayanti Thakur, Malesh Shah
1:10 – 1:30 PM	Design and analysis of low temperature refrigeration system	Anish Poudel*, Lekhnath Gyawali, Suman Bhattarai, Suman Pathak
1:30 – 1:50 PM	Flow and structural analysis of Upper Hewa hydropower project (8.5 MW)	Saurav Gautam*, Sailesh Chitrakar , Dadi Ram Dahal

To Investigate Thermal Conductivity Of Phase Change Material By Incorporating Surfactants

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Keywords - PCM, Paraffin Wax, Thermal conductivity, surfactants

Phase change materials (PCMs) store or release a large amount of heat during their phase transition. It is used in the thermal management system to improve cooling efficiency and save energy. But it has low thermal conductivity, which affects the performance of the Latent Heat Energy Storage System. The purpose of the research is to investigate the thermal conductivity of PCM by mixing different surfactants. Surfactants with varying weights of Sodium stearate, Gum Arabic, and sodium stearyl lactylate are mixed with paraffin wax. A simple and economical experimental setup consisting of a hot plate heater, aluminium heat sink, k-type thermocouple, and data acquisition system are used to analyze the thermal behaviour of paraffin wax. In the experiment, paraffin wax is heated for two hours in a hot plate heater. Then it is taken out from a hot plate heater and cooled in the surrounding environment. Pure paraffin wax's charging and the discharging rate are recorded and compared with surfactant mixed paraffin wax. Results show peak temperature for pure paraffin wax is 66.76°. In the case of sodium stearyl lactylate (SSL), the peak temperature was 68.3°C at critical micelle concentration (CMC) (concentration of surfactants above which micelles form), 69°C for above CMC. For Gum Arabic (GA), the peak temperature was 70°C at CMC and 71°C for above CMC. In the case of Sodium stearate (SS), the peak temperature was 72.12°C at CMC and 73.8°C at above CMC. Results show concentration above critical micelle concentration of Sodium stearate leads best results compared to other samples. Surfactant form micelle, which acts as the conducting medium inside paraffin wax. Hence thermal conductivity of paraffin wax is increased, and the purpose of the research is achieved.

Optimization of Design and Operational Parameters of Bio-sand Filter Using Response Surface Methodology

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Keywords - Bio-sand Filter; Household Filter; Point-of-use Technology; Drinking Water Treatment; Optimization; Response Surface Methodology; Central Composite Design.

The bio-sand filter (BSF) is one of the most widely used household water purification methods as an efficient point-of-use inexpensive technology in the rural areas of developing countries. The efficiency of BSF depends on its design and operational parameters. In the present research, the optimization of filtration by BSF was done using through the approach of Response Surface Methodology, with help of Design Expert Software 11 and its statistical tools. The design parameters taken as factors for optimization were size of sand particles in the media (0.2 - 0.5 mm), height of the filtration media (350 - 550 mm), and headspace (100 - 300 mm). The operational parameters taken as factors were pause time period (12 - 36 hours), charge volume ratio (0.5 - 1.5 of pore volume), and influent turbidity (10 - 50 NTU). Assessment of the influence of these factors on filtration was done by monitoring the effluent water characteristics taken as response like: turbidity (NTU), flow rate (liter per minute), total coliform count (CFU/ml), and Escherichia coli count (CFU/ml). Randomized Central Composite Design (CCD) was used for correlating the factors and developing models for each of the responses. From the study, the microbiological quality of effluent water was found to improve with increase in pause time and decrease in charge volume as well as head space. Moreover, smaller sand particles and increased height of media improved effluent water quality while lowering the flow rate significantly. The decrease in charge to pore volume ratio was found to enhance filtration. Effluent turbidity was found not to be significantly affected by the factors. The optimum values for the parameters obtained through RSM were pause time of 24 hours, sand particle size of 0.3 mm diameter, height of media as 484 mm, headspace of 185 mm, influent turbidity up to 10 NTU, and charge volume as much as pore volume. Under such conditions; bacterial removal exceeds 99.7%, turbidity remains below 1.5, and flow rate of effluent is 0.3 liters per minute. This optimization result can help to design bio-sand filters that can provide optimum filtration when operated with a charge of one pore volume per day.

Numerical Analysis of Erosion and Erosion Induced Vibrations in Francis turbine

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Keywords - Hydroelectric penstock, Subsurface defects, Non- destructive testing & evaluation, Infrared thermography, Pulsed thermography.

During the operations of Francis turbine vibration is one of the main problem as they are frequently operated outside their optimal operating range, with rapid load changes. In hydropower plants, vibrations occur in various parts which can be classified as: hydraulic civil parts such as reservoir, intake, dam, tail race etc. mechanical parts such as penstock, turbine, draft tube and shaft, and electrical parts such as generator and transformer. However, due to the sediments and cavitation problems, the regions around rotating parts such as turbine experiences severe vibration. In the cases where the turbines need to be operated with high sediment load, the vibration problems could be further aggravated due to sediment carrying flow and declination of the surface morphology after erosion. This paper explores the nature of the effect of erosion which contributes to more losses, vibrations, fatigue problems and ultimate failure of the turbine. The study aims to correlate the erosion due to abrasion with the vibration induced by them with the help of CFD analysis of guide vane and runner blade.

Smart Dustbin

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Keywords - Decision Making, Signaling, Path detection and Following, Parent and Child configuration, Path selection

Smart dustbin is a dustbin capable of assisting differently able people and patients in hospitals to manage their waste products in an easy and healthy manner. The dustbin is initially placed in the default location in a room. Whenever the patient wants to use the dustbin, the patient can press a button attached in a bed to give out a signal to the dustbin. The dustbin, upon reception of signal, processes the signal to decide the bed number from being called out and the path to travel to the bed. The path is a black line which a dustbin follows using a line following mechanism. Upon reaching the calling bed, the lid of the dustbin opens automatically and receives a waste product. Upon complete reception of the waste product, the patient will have to press the switch again to send the dustbin to its default location. For path following, the dustbin will utilize an infrared (IR) sensor, radio frequency (RF) module for signaling and Arduino microcontroller board as an on-board computer for all necessary calculation, processing and decision making. To open and close the lid, a servo motor is used and a Bo-motor is used for the movement from one place to another. To stop it from colliding with people walking around, Ultrasonic sensor is used to sense the distance of people.

In our specific test condition, we are considering four beds in a room arranged in 2x2 matrix arrangement and 2 dustbins set in parent and child configuration.

Design, Fabrication And Performance Evaluation Of Adjustable Mechanical Fruit And Vegetable Grader.

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Keywords - Mechanical grader, Adjustable, Quality, X-bar chart.

Design, fabrication and testing of an Adjustable mechanical fruit and vegetable grading machine was evaluated in this Paper. It aims to contribute in the agricultural sector for making a qualitative grading of varies sizes of spherical fruits and vegetables. Seeing the present scenario, Nepal being an agricultural country it lacks the proper grading management system at the farmer level. As grading of fruits and vegetables after harvesting is an essential step. Grading is basically done by human eye judgment. Human operations may be inconsistent, less productive and time consuming. Likewise, commercial fruits and vegetables graders are expensive and beyond the reach of ordinary fruits and vegetable growing farmers having small land holding. Keeping in view the need of market desired by farmers and quality conscious consumers an efficient small capacity fruits and vegetables grader prototype was designed and developed. Three functional unit were fabricated- Hopper to hold, grading frame with pipes and frame with compartment to collect graded product. The machine consists of divergent stainless-steel pipes, and the whole frame is inclined at 17° with the ground. It is operated using AC motor along with cam, follower mechanism and spring for vibration. For the design and testing, 7 pipes were taken with 4 number of compartments. Eventually total four graded product is the output of the machine, with above constraints. Under this condition, fruits and vegetables of diametrical size 1.5-3.5 mm can be graded by this machine. During the testing of machine 225kg/hour of fruits and vegetables was found to be graded. The capacity of the hopper where the input is placed is 10 kg. Different sample size was taken for each observation and X-bar chart was plotted. All those data were found to be statistically under control that supported for the quality grading of fruits and vegetables. During testing smooth operation was ensured by efficient human supervision. With this machine one can get a qualitative grading for all spherical fruits and vegetables with lesser time and effort.

Comparative Structural and Thermal Analysis of Metals for Vented Rotor Disc application

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Keywords - Vented Rotor disc, Von-mises stress, deformation, drill hole, slot hole

Vented Rotor disc is the braking components used in stopping the running system, which has two parallel concentric plates joint by the vent with side drum on one face. The disc rotates at wide range of speed and then generates thermal and structural distortions while the energy in the form of kinetic turns into heat energy during stopping. The energy dissipation and stress during stoppage gradually produces wear and fatigue in the system decreasing the service life. This study helps to understand the nature and behavior of the rotor disc under the given boundary and loading conditions which would help to understand the reliability, effectiveness, and safety conditions of the proposed model. The purpose of the study is to conduct the structural and thermal analysis of the rotor disc for both drill and slot holes of various materials under similar conditions. Materials are selected on the basis of availability and physical features that include aluminum alloy, gray cast iron, structural steel, and titanium alloy. Prior to modelling, the mechanisms and significance of the vented rotor disc were used on the rotor disc for both drilled disc and slot disc along with various engineering materials. The modeling of the rotor disc is performed on SolidWorks. After that, finite element analysis is used for carrying out to perform the static structural and thermal analysis of the disc. The models of the rotor are extensively analyzed based on the total deformation, Von-mises stress and strain, temperature distribution and the gradient of the heat flux on the body under the provided conditions. Among the studied material, titanium alloy has the least deformation and highest temperatures drop. The model of vented disc for both drill and slot can perform under the given conditions without any failure and ensure safety as well.

Investigation On Effect Of Post Processing Techniques Of FDMBased 3D Printed Parts On Its Mechanical Strength

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Keywords - 3D Printed, Post Processing, Annealing, Epoxy filling, Mechanical Strength, Poly lactic Acid (PLA), Thermoplastic Polyurethane (TPU), Young's Modulus

Additive manufacturing can be considered as the future of manufacturing by allowing customizing material composition, processing conditions, and geometry of structures or objects which can take over conventional manufacturing process. Fused Deposition Modeling (FDM)/ 3-dimensional (3D) printed thermoplastic polymer parts have reduced mechanical strength because of the temperature difference between the deposition layer. This paper analyzes the effect of post processing on mechanical strength of FDM printed parts aimed to increase their applicability for functioning application. Two types of post processing; Epoxy filling and annealing for FDM printed parts are presented in this paper. PLA (Polylactic Acid) polymer samples were chosen for annealing with 100% infill whereas TPU (Thermoplastic Polyurethane) and PLA both polymers were chosen for epoxy filling where samples were printed with different infill and raster angles. (American Society for Testing and Materials) ASTM D638 test standard dog-bone tensile test samples and solid cylindrical compressive test samples were packed in sodium chloride as sodium chloride acts as anti-caking agent and can also be grinded into more fine powder to act as better constraint and then heated to a furnace at 200°C for 2.5hr. Though PLA has glass transition temperature between 50 and 80°C and melting temperature between 170 and 180°C it is heated up to oven temperature 200°C due to the fact that the sample is packed inside sodium chloride which is resistance to process temperature and the overall temperature must be maintained up to 200°C to make change in the PLA sample because at 180°C oven temperature PLA hadn't change its phase. Epoxy filling was done for both PLA and TPU materials printed with 25% and 50% infill and raster angles of 45° and 90°. As a destructive testing; tensile and compressive testing were done which showed the significant increase in the mechanical strength. Tensile and compressive test result showed an improvement in mechanical strength of annealed PLA samples as compared to untreated sample of about 23.06% and 2.08% respectively and Young's Modulus is of about 28%. Likewise, epoxy filled TPU samples showed higher tensile strength than unfilled sample of about 35.18% and compressive strength is of about 128% and Young's Modulus is of about 140%. But epoxy coated PLA samples showed lower mechanical strength than unfilled sample. These results show that the investigated annealing increases the mechanical characteristics of FDM printed PLA samples which can further be applicable for functioning application. Epoxy can also be applicable for providing the better mechanical strength for low strength material like TPU.

A Review On Micro-district: It's Implication On Transportation System

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Keywords - Micro-district, transportation, infrastructure, roads, microraiion

Adoption of an ideal transportation system is essential for optimization of scarce resources and raising social welfare. Micro-district, also known as microraiion, is a concept in urban planning based on the idea of collective housing. When juxtaposed with properly funded and maintained public transportation infrastructure, this concept can greatly minimize the use of private vehicles such as cars, increase social interaction and decrease space used in parking. This unused land can in turn be used to provide more housing to the people. The use of micro-district, along with tall building structures can prevent sprawls. The use of public transportations such as trains can prevent the space used in the construction of roads, highways and expressways. In this concept, unlike concepts that rely on a large number of roads and highways, one doesn't need to increase the number of lanes to account for a tiny increase in population. This, along with decrease in use of fuels from minimum use of private vehicles, can help save money and also decrease pollution. This analysis is exploratory in nature. The published work in this line of thinking is in continue from the side of the author. The sources are obtained from Google Scholar and are mostly in the historical context of housing in Eastern bloc. Keywords such as urbanization, micro-district, affordable housing, collective housing and microraiion were used for the collection of literature. We chose to limit the scope of the study in the context of Eastern bloc because of the ample availability of past literature about housing in Eastern bloc. This paper explores theoretical grounds for the implementation of the concept of micro-district in the present time.

Design Of Steering And Braking System Of An Electric All-Terrain Vehicle

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Keywords - Brake Caliper, Ackermann Angle, Module, Brake Pedal force

However the power steering system is advantageous, it has some complications regarding design, fluid leakage and cost. So, for EATV we have used rack and pinion manual steering system which overcome the limitations of power steering. The design was done on SolidWorks comprising its essential parts. The calculations of necessary parameters were performed and force of 116.11N required to make a turn on steering wheel was calculated. Braking system in any vehicle is the most important subsystem of the vehicle. For our EATV, we are certain that disc brakes are going to work much better. EATV will have to go through long, rough, terrain, wet endurance course which will give challenges to our braking system and from research and study it has been proved that the disc brake will work much better for such applications. The prime concern of brake is to lock both the wheels at same time. So, different caliper at front and rear wheels were used. For front wheel, a larger caliper size of 38 mm was used and for rear wheel smaller caliper of 20 mm was used. This was considered taking in mind the availability in market.

Static Test Pad For Solid Rocket Motors

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Keywords - Test Pad, Thrust, Rocket Motor, Deviation

Static Test Pads are stationary mechanisms that hold a solid rocket motor, measuring the different parameters of its operation including thrust and temperature to better calibrate it for launch. This paper outlines a specific STP designed to test high powered rocket motors with a thrust upwards of 4000N and limited to 6500N. Using curved surfaces and an ergonomic design, the STP has a delicately engineered façade/case with a focus on stability and axial calibration of thrust, inspired by launch systems, the STP has a reliable structure to ensure it can handle the thrust. This paper describes the design, operation and working of the STP and its wide scale uses given the growing market of aviation enthusiasts. Simulations on the CAD model in Fusion 360 provided promising results with a safety factor of 2.645 at maximum thrust, and stress limited due to the curve surface and lack of vertices. The design includes a specific portable mechanism with cost an integral part of the design process to make it accessible to small scale rocket developers with limited resources. The mechanism includes easily removable threaded screws allowing it to be separated into 4 different layers to be carried individually to the testing site, this poses a few structural challenges however the sloping and gradually decreasing lumen on the structure results in a load distribution enabling it to be used. The motor mount is also retractable to properly adjust the motor to maintain a stable orientation, along with a removable avionics system, attached through adjustable clamps allowing for better portability for users. A PCB was also designed as part of the test pad design process to help obtain results, with visual output and various virtual terminals to collect data of different parameters. The circuitry was simulated using 'proteus' and a special virtual interface with auditory commands was also created for accessibility and wide-scale implementation. The design has been simulated at multiple occasions with a physical PCB and think-speak integrated system built for the avionics of the system. Given the rise of students and professionals alike building high powered rockets, the STP described in this paper is an appropriate option at approx. 7600 with limited cost, portability, accuracy, and versatility. There are two types of STP's vertical or horizontal, the one discussed in this paper is vertical to utilize the axial component of thrust, providing an innovation simply nonexistent in the current landscape.

Design, Modeling, And Simulation Of Power Train Of An Electric All-Terrain Vehicle

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Keywords - Battery Bank, Motor Controller, Drive cycle, Tractive force and Energy

The power train is crucial because without the system working properly, the vehicle don't move forward. EATV uses battery as a main power source and is driven by motor. Lithium ion battery was used for the EATV due to its reliability, efficiency and lifespan by comparing with the EV batteries like Lead-acid and Nickel Metal Hydride at "deep cycle" condition. The computer modeling of power train were performed in MATLAB and Simulink to find the ideal requirement of parts involved. A simulation was modeled to calculate the average energy consumption of the EATV. The battery energy capacity was required to be 24kW-hr analytically. The power requirement of the vehicle for the system was calculated. For the vehicle of 540 kg mass, the overall tractive power requirement to run the EATV at average velocity of 25km/hr on 25% grade was found to be 10.57kW. From the Simulink Simulation, it was found that the average energy consumed by the Electric ATV for the provided drive cycle of total length 7898 m in the time interval of the 2474 seconds was 59.35 Wh/km for 0% grade condition and 371.23 Wh/km for uphill 25% grade condition. Based on the calculation of Power and torque requirement, the selection of the motor is carried out. Since the minimum power requirement was found to be 10.563kW, the Brushless DC Motor of rated power of 12kW was selected. Assuming the range of the EATV to be 40 km in once full charged and the average speed of the EATV is taken as 25 km/hr., the operating time of the vehicle was calculated to be 1.6 hour.

Heat Transfer Analysis of a Constant Area Straight Rectangular Fins of a Petrol Engine With Different Extended Surface

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Keywords - Combustion, engine, heat transfer, finite element analysis, fin, extensions

An internal combustion engine continuously generates heat which has to be dissipated away instantaneously from the engine. The use of properly designed fins could help in increasing the rate of heat transfer and thus cooling the engine faster. In this research, heat transfer and temperature distribution in the engine with constant area straight rectangular fin with non-extended surface, fin with rectangular extended surface and fin with rectangular extended surface and hole is analyzed to find out best suited geometrical extension of the fin for higher heat transfer rates. Grey Cast Iron is the material selected for chosen Yamaha FZ-S V3 petrol engine. The analysis is carried out in Ansys Workbench computation tool where the engine core and ambient temperature of 15000 C and 220 C respectively are taken as main input parameters. The steady state thermal finite element analysis resulted in the maximum heat transfer rate of 0.20308 W/mm² in engine with rectangular surface extensions with hole followed by heat transfer rate of 0.19125 W/mm² in engine with rectangular surface extension and the least heat transfer rate of 0.16043 W/mm² in fin with no extensions.

A Computational Approach For Prediction Of The Critical Region Of Francis Runner Blade Under Varying Load Conditions

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Keywords- computation, erosion, runner blade, sediment, velocity, pressure.

Turbine runners are the prime components for converting pressure energy to produce useful work and shape changes due to wear affect the water flow properties. Erosive wear is dependent on the properties of the sand, turbine materials, and particle velocity. This study discusses sediment erosion in turbine runners in the largest operational hydropower plant in Nepal (Kaligandaki "A" Hydropower), which has a Francis runner blade. A suitable numerical (2-dimensional) model of the reference case is created and calculations for parameters like velocity and pressure are obtained and validated using a grid independence test. After the grid independence test, the model with 81830 meshing elements is taken with an inlet pressure of 1128150 Pa. For steady-state computational analysis, elementary locations named A, B, and C are taken into consideration for parameter calculation referring to the leading edge of the pressure side, the middle of the suction side of the blade, and near the trailing edge of the pressure side respectively. The maximum pressure of 1047750 Pa and velocity of 6.1549 m/s are obtained for the inlet pressure of 1128150 Pa at point A which is at the leading edge of the pressure side of the blade. The pressure of -527450 Pa and velocity of 24.59m/s are obtained in the middle of the suction side which is point B. Likewise, the pressure of -40582.2 and velocity of 21.8 m/s are obtained for the case at point C, near the trailing edge of the pressure side of the blade. For full load and part load analysis, inlet pressure is varied and result are observed at the same location A, B, and C. From this analysis it is concluded that there is variation of pressure at different location on turbine blade when inlet pressure is varied. Thus from the steady-state analysis, the high pressure is obtained at the leading edge of the pressure side of the blade, so it can be concluded that the leading edge of the pressure side is the critical region affected by erosion. This result obtained from the computational numerical approach points to the conclusion that the critical region against the sediment erosion in the Francis runner blade, predicted against velocity and pressure field, is the area around the leading edge and trailing edge of the pressure side.

Production Of Fuels By Pyrolysis Of Waste Plastic

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Keywords - Plastic Waste, Pyrolysis, Reactor, Crack gas, Fourier Transform Infrared Spectroscopy

This paper describes catalytic process of the plastic waste materials in order to obtain an alternative fuel from three plastic waste Polypropylene (PP), Polystyrene (PS) and Polyethylene (PE). Pyrolysis is the thermochemical decomposition of plastics at elevated temperatures (in absence or little supply of oxygen) into a range of useful products: gas, liquid and solid residue. These waste plastics consisting of PP, PE and PS, are first sorted manually and crushed by using crusher and finally feed in the reactor enclosed in the burner maintaining the reaction temperature about 500 °C. Nitrogen gas is used to create inert environment and for fluidization in reactor. The produced cracked gas is now sent to be condensed to a condenser followed by the series of cyclone separator and electrostatic precipitator then finally feed into the liquid vapor separator. Fourier Transform Infrared Spectroscopy (FTIR) analysis shows that the liquid products are usually composed of higher boiling point hydrocarbons along with more valuable materials and other hydrocarbon. The yield of the products according to increase in temperature is also shown in this paper.

Experimental And Numerical Study Of Sediment Erosion In Turgo Turbines

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Keywords- Sediment erosion, Turgo turbine, concentration, rpm.

There is a high concentration of sediment in the rivers of the mountainous country like Nepal. Since the turbines in the hydropower plants in Nepal are exposed to sand-laden water, the erosion of electromechanical components is inevitable. This study uses the existing erosion testing facilities of Turbine Testing Laboratory (TTL), Kathmandu University, to determine the erosion-prone region and erosion rate in the Turgo turbine's runner. A pico-scale Turgo runner with casing was fabricated using a sand-casting process. Using coated layers of different colors, the erosion-prone areas in the blades are identified. The test consisted of a mixture of sand and water with varying concentrations and rotating speeds. The erosion rate of the blades is calculated through weight loss measurement after each set of experiments. The rate of erosion increases as the sediment concentration increases. The increase in the speed of the turbine also increases the rate of erosion. A CFD-based simulation is performed on the same turbine using the Eulerian-Lagrangian scheme for modeling the particle transport in the fluid. The result of the simulation is compared with the experimental analysis, which shows an agreement in the erosion pattern observed on the blades using two different techniques. The general erosion model is also developed for the Turgo turbines.

Prospects Of Central Heating, Floor Heating And Wall Heating Systems: A Review

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Keywords - Heating System, Low Temperature, Thermal Comfort.

In light of low winter temperature conditions, understanding and application of heating technologies is paramount to ensure thermal comfort of occupants of a building. Central Heating, Wall heating and Floor Heating are most prevalent methods of heating in market. Understanding capabilities of these types of heating is key for empirical deployment of these modes of heating. This comparative review compares between these three modes of heating, based on heating principle of each system based on, related costs and energy usage by the systems. Literature review as primary method of study of the respective systems. Due to varied installation area and technologies, heating obtained by each system varies significantly, with each being justifiable for use in different situations. Thus, a preliminary feasibility study of Central heating, Wall heating and Floor Heating is studied in terms of coefficient of performance, also guiding future research.

Knee Flexion/Extension Angle Measurement For Gait Analysis Using Machine Learning Solution “MediaPipe Pose” And Its Comparison With Kinovea®

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Keywords - Human Gait Analysis, Pose Estimation, Machine Learning, MediaPipe, Kinovea®, Gait Databases

Human Gait Analysis is crucial in diagnosis, monitoring, treatment as well as rehabilitation. It requires measurement of gait parameters like joint angles, angular motion, ground reaction force (GRF), momentum, step width, step length, velocity, etc. This study introduces a marker-less and cost-effective approach for measuring one of the gait parameters i.e., knee flexion/extension angle, and verifies it with an existing standard marker-based approach. The proposed approach calculates knee flexion/extension angle via Machine Learning (ML) pose estimation model “MediaPipe Pose” and Computer vision (CV) without the use of markers. For the verification of accuracy, the obtained values are compared with the data on each video frame obtained from Kinovea® which is a marker-based motion analysis software. High correlations ($r = 0.941$) between Kinovea® and MediaPipe Pose were observed. Similarly, the mean absolute error of knee angles between MediaPipe Pose and Kinovea® was 5.88 degrees. The research provides an alternative marker-less approach for knee flexion/extension angle measurement for gait analysis. The research shows that knee flexion/extension angle can be successfully and accurately measured using ML Solution for high-fidelity body pose tracking. The research is useful for professionals involved in the field of biomechanics, sports medicine, physiotherapy as well as other medical fields.

Simulation and Field Based Study of Thermal Performance of a Building - A Case Study

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Keywords - TRNSYS, Building Analysis, National Building Code

Concerns about building thermal performance and energy consumption are fast growing as they account for roughly 40% of worldwide annual energy use. Building construction in Nepal is controlled by the National Building Codes (NBC), which focus solely on structural considerations and ignore thermal behavior. As a result, houses tend to be too much warm and too much cold during summer and winter respectively due to lack of passive heating and cooling mechanisms considered during construction phase. The Thakle Integrated Settle, built by the Department of Urban Development and Building Construction (DUDBC) under the National Reconstruction Authority and supported by Oxfam Nepal, was the subject of this research. The buildings performance of the chosen location was analyzed using a field and TRNSYS simulation-based technique. Using meteorological data from Meteornorm software, the TRNSYS model was created to examine the performance in terms of internal air temperature and heating/cooling load of two buildings with different orientations, e.g., North-East (NE) and South-West (SW). According to simulation results, there is a heating demand that covers roughly 37% of the year, while cooling and comfort conditions were 32% and 31%, respectively. For NE and SW facing buildings, heating demand was 4.10 MWh and 4.07 MWh, while cooling demand was 1.302 MWh and 1.309 MWh respectively.

Simulation Of Passive Thermal Retrofitting Techniques In Earthquake-Resistant Building Community: A Case Study Of Buildings In Thakle Namuna Basti, Melamchi, Nepal

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Keywords- Passive Retrofitting, Passive house, Thermal Comfort, Building Comfort.

This study analyzed the effectiveness of passive house techniques on buildings in a small community called Thakle Namuna Basti of Melamchi, Nepal. The community was surveyed for all the required details for their thermal comfort and load requirements. Using TRNsys software, an annual load demand was simulated before and after using proper passive house techniques. The results showed an improvement of about 35% in retaining heat in winter and reducing the load. But, during summer the cooling load increased by 4%.

Design Of A Supersonic Nozzle Using Method Of Characteristics (Moc) To Enhance Non-Equilibrium Flow Pressure Recovery At The Outlet

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Keywords - Method of Characteristics, sonic throat, Mach number

A nozzle is a geometry with a varying cross section which is used to direct or modify flow. They are usually incorporated to control the rate of flow, speed, direction and pressure. In a supersonic flow, characteristics are 'lines' oriented in specified directions along which disturbances (pressure waves) travel. Different flow parameters in a nozzle are varied according to various applications, which results in a certain change in the geometry of the nozzle to obtain the desired flow. The aim of this research work is to design a fine contour for a nozzle of a booster by applying the Method of Characteristics (MOC) to increase the exhaust flow pressure recovery, obtain a sonic throat, and potentially obtain the highest possible Mach number and pressure expansion in the divergent section. The MOC assumes an inviscid flow field, but the flow itself is non-equilibrium and hence it captures the flow field that has some unburnt mixture and also the gas constants are varying due to varying mass fraction or changing temperature. With the help of python program, the nozzle wall coordinates will be obtained from the intersection of characteristic lines, between nodes that conserve the total mass flow rate for non-equilibrium flows where various parameters like chamber pressure, chamber temperature, thrust value, inlet dimensions, etc. are given by the user and the contour for nozzle is developed such that it best suits the user's input condition.

A Review On Cleaner And Safer Propellant Materials For Space Vehicles And Their Characterisation

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Keywords -

Chemical fuels are used as rocket propellant in the majority of today's rockets. A material used by a rocket as, or to develop in a synthetic reaction, the response mass (propulsive mass) that is fired out of a rocket engine to offer push, and therefore give shuttle thrust, is known as rocket propellant. Satellites and space stations that stay in orbit for an extended period of time use hypergolic, highly energetic fuels that ignite instantly when exposed to an oxidizer. The current generation of hypergolic fuels is based on hydrazine, a highly poisonous and extremely unstable chemical molecule made up of nitrogen and hydrogen atoms. This paper focuses on fuels of different types of rocket propulsion systems and frameworks catering to the need of cleaner and safer propellant materials. Developments and breakthroughs in fields of (Metal Organic Frameworks) MOFs, Hybrid Rocket Technology, Hydrogen Propellants, Ammonia Borane are reviewed and characterized in this paper.

Study Of Tempering Heat Treatment Process On Welded Mild Steel

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Keywords - Mild steel, Turbine, Mechanical properties, Post weld heat treatment (PWHT), Tempering.

Mild steel having a carbon content of less than 0.25% displays good weldability and machinability, making it a suitable material for many engineering components including hydraulic turbines. In this work, an experimental study is carried out to investigate the changes in mechanical properties of the mild steel when subjected to welding and tempering heat treatment cycle. Four experimental cases were considered; i) as-received, ii) tempered, iii) welded, and iv) post-weld heat-treated (PWHT). Charpy test and tensile test were done to investigate the impact energy and fracture strength of the tested specimens. A total of 16 tensile tests and 16 Charpy tests (4 tests per case) were conducted. Fracture surface studies were performed to determine the types of fracture on samples of all four cases. The results of the Charpy test according to the toughness of samples were: Heat treated (165J) > as-received (129J) > post-weld heat-treated (110J) > welded (89J). Similarly, the results of the tensile test according to fracture strength were: heat-treated (943.28 MPa) > as-received (876.18 MPa) > post-weld heat-treated (654.67 MPa) > welded (494.75 MPa). The hardness of samples was predicted from tensile strength, using the correlation of hardness and tensile strength of mild steel. The predicted hardness at four cases of samples was: heat-treated (175.330 RHB) > as received (172.153 RHB) > post-weld heat-treated (160.355 RHB) > welded (149.633 RHB). It was observed that the strength of welded samples is less as compared to the as-received case and there was an increase in strength of samples after being heat-treated and post-weld heat treated. For the welded samples, welding defects in the form of voids, incomplete fusion of weld metal with base metal were observed, and tensile residual stress contributed to lower impact energy and fracture strength. The tempering process helped further fusion weld metal with base metal, reduction in residual stress in the welded sample, and graphitization of carbide in the equilibrium state of microstructure to gain higher strength of samples. Thus, it was concluded that maintenance of turbine by welding process should be followed by tempering heat treatment process to reduce heat affected zones and possible accumulation of residual stresses.

A Study On The Traditional Kol Technology Of Nepal

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Keywords - Kol, Ghani, traditional, oil extraction, optimization

Kol is an improvised version of Ghani, an oil extraction process that carries 4000 years of history and was invented by the Harappan civilization. In Sanskrit literature of about 500 BC, there is a specific reference to an oil press that marks this machinery as an important part of understanding the social and agricultural life of people of that era. Kol uses wood-based components to achieve cold press and compaction of oil seeds. The main objective of this paper is to do an extensive study on the traditional Kol technology of Nepal and analyze its manufacturing processes. This is achieved through in-person discussion and review of locally available community-based Kol from Arghakhanchi. There is a need for the update and optimization of this machinery regarding efficiency improvement, material upgrading, human resources development, and economic viability for rural communities.

Conversion of an IC engine vehicle to a battery-electric vehicle

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Keywords - IC engine, battery electric vehicle, Maruti Suzuki 800, conversion, traction motor.

The gradual increase in carbon emission along with the greenhouse gases result in increased global warming due to the smoke emission from the IC engine vehicles has adversely degraded the environment quality and human health. The global data of 2018 show that road transport accounts for three quarters (74.5%) of the total emissions where passenger vehicles contribute 45.1% and trucks carrying freight contributes 29.4%. Different alternatives have been studied and developed for the reduction of such emissions from the transportation sector. The global world is transitioning towards cleaner means of transportation and it is high time for Nepal to focus on clean transportation technology. Almost 99.9% of the transportation sector of Nepal is dependent on petroleum and diesel-based fuels. In such a scenario, electric vehicles could be one of the alternatives. This paper studies the possibility of converting IC engine vehicles to battery electric vehicles in the transportation sector. An internal combustion engine Maruti Suzuki 800 car model is selected for the conversion into BEV. The internal combustion engine and other related components are removed and replaced by the electric traction motor, battery, and other electrical components with the existing gearbox and transmission system. The components are selected as per the requirements based on the calculations. An electric motor is powered by a lead-acid battery and the electric motor transfer the power up to the wheels that propel the vehicle. A drive cycle analysis of the electric vehicle was studied in MATLAB/SIMULINK and is presented in the paper. Finally, the vehicle is successfully tested and run on the track without any technical problems. The overall project shows the technical feasibility, an adaptation of new technology, technology transfer, and the reuse of an old IC vehicle in the transportation sector in Nepal.

Assessing the Performance of a Demonstrative Hydrogen Fuel Cell Powertrain in the Chassis of an Internal Combustion Engine Vehicle

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Keywords - Hydrogen fuel cell, green hydrogen, mathematical modeling

At the present day, it is estimated that approximately 2 billion internal combustion engines (ICEs) are being used around the world. In 2020, around 7.3 billion metric tons of carbon dioxide (CO₂) emissions is recorded through global transportation sector accounting for 41 percent of global emissions. To solve pollution challenges related with ICEs, recent advancements of alternatives to ICEs have pushed the globe to establish clean energy sources such as hydrogen fuel cells. Hydrogen-powered fuel cell vehicles (FCEVs) reduce emissions by over 30 percent compared with conventional gasoline vehicles and hence, converting an internal combustion engine vehicle to a hydrogen fuel cell vehicle will help the development even more because the old ICE vehicles would not have to be abandoned. FCEVs are seen as a true replacement between BEVs and ICEs since more amount of energy can be stored in less space as compared to BEVs.

The objective of this paper is to analyze the energy consumption of a hydrogen fuel cell driven motor in the internal combustion engine vehicle chassis of Maruti 800, through mathematical modeling, then compare the efficiency with that of an ICE driven system. The analysis provides details on the optimization of drive system components to maximize the fuel cell energy consumption efficiency based on fuel cell power source requirements for a range of velocities and road gradients. The modifiable specifications of drive system components in the mathematical model ensures reproducibility for any drive cycles and system scenarios.

Design and Static Structural Analysis of Electric Go-kart Chassis

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Keywords - Electric Go-kart, Stainless Steel, PVC-U, PVC-O, Structural Analysis

A go-kart is a type of open-wheel vehicle which comes in all shapes and forms, from motorless versions to high-powered racing machines. Steels are the dominant materials for manufacturing go-karts and other low-density materials like PVC are seldom used. Steels have higher stability and can provide a higher factor of safety compared to PVC materials, however, when the PVCs are used with Oak white wood and similar materials for the base support, comparable results as that of the steels can be obtained. Thus, we have used PVC Materials and Structural steel for the static analysis of the chassis with and without the wooden base. Due to the fact, that the tensile strength of the PVC-O is twice that of the PVC-U, significant deformation can be observed in the PVC-U chassis. However, both the materials show similar behavior when the wooden base is provided and the deformation between the two materials defers only by 8.6%. When a wooden base is used as a support factor safety of 4.6677 and 4.3579 is obtained for PVC-O and PVC-U. Similarly, the corresponding critical load for PVC-U, PVC-O, and Structural steel are obtained to be 3050.53N, 3267 N and 5200.4 N. Aforementioned PVC materials have low density and weigh total (with driver) 86 kg and 85.6 kg respectively which increases to 117 kg when structural steel is used. Upon analysis, both the PVC-U and PVC-O have shown comparatively the same results for the structural stability. In addition, it can be inferred from this project that the structural integrity of the body is significantly influenced by the support provided. In order to build and produce lightweight electric vehicles, the option of low-density higher stiffness materials may be supportive. Not only does the use of PVC with base support offer comparative stability like steel, but the low weight often utilizes lower power, ensuring both technological and economic benefit.

Failure Parameters in Battery Recycling Technologies

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Keywords - battery recycling, pyrometallurgy, hydrometallurgy, LIBs, lead-acid

Battery recycling is an effective method for addressing the associated issues in terms of environmental impact, economic feasibility, and technology perspective. According to the International Energy Agency, electric vehicles produced in 2019 produced 500,000 tons of Li-ion Battery (LIB) waste, and the total amount of waste generated by 2040 could amount to 8 million tons. With such hazards, conservation of the environment and minerals are hindered unless recycling technologies are introduced. Various pyrometallurgy and hydrometallurgy techniques are used in different combinations to recover battery materials based on the studied technologies. In spite of the numerous research achievements that have been made concerning the recycling of LIBs and lead-acid batteries, each technology has its limitations and challenges which are hindering sustainability.

The core objective of this research is to address the failure parameters with a comparative study of battery recycling technologies. Hence, this paper has addressed the scenarios of recycling technologies globally. A discussion of battery recycling and the problems/barriers with technologies and research efforts from the perspective of manufacturers, consumers, and different stakeholders is presented.

Modifications in Internal Combustion Engine for Performance Improvement – A Scoping Review

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Keywords - internal combustion engine, emission, performance, efficiency

Global transportation is powered by the continuous burning of fossil fuels resulting in overuse of petroleum products followed by emission of toxic chemical components. In recent times, expansive research in modifications and alternatives of Internal Combustion Engine Vehicles (ICEVs) is being done because researches show that complete replacement of ICEVs is shortsighted which emphasizes need to upgrade current ICEV technology. This paper aims to review research related to alterations in ICEVs for performance enhancement, especially to reduce emissions from the vehicles, so as to come up with possible technological solution for vehicles operating in Nepal. The papers were gathered using the keywords- "Internal Combustion Engine" and "Modifications" through scientific databases like: ScienceDirect, PubMed, ASME library and IEE Xplore. The results are further bolstered through questionnaire survey of experts working in automobile sector of Nepal. The review shows that powertrain electrification, water injection technology, variable compression ratio, lean-burn technology, hydroxyl gas infusion with diesel, etc. are the methods to improve performance of engine and its components, and reduce emissions. The possible options are hierarchically organized based on a questionnaire survey.

Design And Analysis Of Four-Wheel Steering Mechanism

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Keywords - Turning radius, Steering mechanism, Prototype.

Four-wheel steering is a serious effort on the part of automotive design engineers to provide near-neutral steering. Also in situations like low-speed cornering, vehicle parking, and driving in city conditions with heavy traffic in tight spaces, mechanisms that result in less turning radius can be achieved by implementing a four-wheel steering mechanism instead of regular two-wheel steering. The main aim of this project is to turn the rear wheels out of phase to the front wheels. In order to achieve this, a mechanism that consists of chain and sprockets and intermediate shaft which transmits 100 % torque as well turns rear wheels in out of phase was developed. The mechanism was modeled using Solidworks and static load analysis of chassis was done in ANSYSv19 and a physical prototype was realized. The prototype was tested for its cornering ability through a constant radius test and was found to 50 % reduction in turning radius.

Study And Optimization Of Muffler To Reduce Back Pressure

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Keywords - Backpressure, Muffler, Design, Simulation

The increase in fuel emissions from a vehicle along with the production of unwanted noise has been a major contributor to air and noise pollution while we look around our surrounding. Exhaust system is the exhaust gas pressures that is produced by the engine to overcome the hydraulic resistance of the exhaust system in order to discharge the gases into the atmosphere. The inverse relationship between noise and backpressure is undesirable as an ideal muffler must have small backpressure and produce minimum amount of noise. The efficiency of the system will increase as more air is allowed to flow through the system, which technically means trying to keep backpressure as low as possible; the main focus of our study. The objective of our project is to identify the parameters that are most responsible for change in backpressure and find their relationship with it. The parameters we decided upon were diameter of perforated holes, distance between holes and number of holes. After that, the dimensions of parameters mentioned will be altered on a standard muffler model to find how the results are affected when CFD analysis is done on Fluent with different boundary conditions. Finally, the simulation results are displayed with contour plots for easy visualization.

A Detailed Study On The Life Cycle Of Leaf Spring In The Context Of Nepal

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Keywords - Leaf Spring, Life Cycle, Fatigue, Miner's Rule

Leaf springs are used in the vehicle as a suspension system. Leaf spring being the main component of the vehicle suspension system affects the mechanical behavior of vehicles like vibration, stability, damping, and other aspects like comfort. However, depending upon the geography, temperature, and road conditions, its fatigue life may vary. The general road in Nepal is categorized as highway, mountain roads, and rural area roads. Vehicles are operated on these roads under variable loading conditions. In the context of Nepal, there has not been a detailed study regarding the life period of Leaf springs. As a result, this paper discusses the fatigue life of leaf springs used in heavy vehicles in Nepal. This paper aims to address the causes of fracture and fatigue in the leaf spring and determine the fatigue life of the leaf spring under variable loading conditions. Identification of the fatigue failure at an instance can be a crucial part and can prevent accidents and other heavy losses. The real-life data for the number of repeated stress cycles at a particular stress level is obtained using a sensor on a public vehicle, and different surveys related to the frequent maintenance, and replacement of leaf springs are conducted among the bus owners and workshops. To predict the fatigue life Miner's rule is used. Miner's rule calculates the fraction of damage done due to different stress levels for different fatigue cycles. Finally, through a thorough study, a detailed life cycle of Leaf spring is assessed using Miner's rule.

Parametric Design and Optimization of Laboratory Scale Hydrogen Value Chain

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Keywords - green hydrogen, parametric modeling, optimization

Hydrogen technology is a stand-in technology able to meet variable power demand and overcome grid outages. The hydrogen value chain is an integrated technological system with several parameters. The laboratory setup of the hydrogen value chain helps to understand and optimize parameters, as well as provides a skeleton for industrial-scale development. The alkaline electrolyzer and storage systems are analyzed using different parameter-based scenario models. A mathematical model for the parameters such as voltage, molar flow rate, pressure, energy, etc. has been identified. A mathematical model is used to determine the optimal size of the electrolyzer based on a given set of parameters. For the same power demand in end-use, the parameter-based model is then analyzed for optimum storage sizing. An end-user hydrogen demand is tested with a 5kW PEM Fuel cell. A mathematical model is presented to lay the foundation for sizing the laboratory-scale hydrogen value chain.

Design and Development of Hydrogen Transmission and Refueling Station for Research Purpose

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Keywords - EVs, FCEVs, SAE J2601, Green Hydrogen

The severe outcomes of harmful exhaust gases from gasoline vehicles on the environment and human health have led the entire automotive industries to think of alternative vehicle technologies that are rather environment friendly. Although EVs are clean means of transportation, EVs battery and motors production requires toxic minerals and electricity production by non-green methods which cause heavy air pollution. Hydrogen FCEVs is one of the possible solution to it as its source of energy is green hydrogen. For FCEVs to flourish there is a need of Hydrogen Infrastructures like hydrogen production, transmission and refueling station. This report presents an overall system design of hydrogen transmission and refueling station having main units like compressor, chiller and dispenser coupling. The suitable system design is done under SAE J2601 standard, where hydrogen gas produced onsite flows into a reciprocating booster compressor wherein reaches a pressure of 200-300 bar. High pressure and fast flow rate during fueling causes significant rise in temperature inside vehicle tank which is a major risk factor. To mitigate this temperature rise a chiller is used to cool hydrogen gas to -40°C. This report encompasses the selection of components, study of fueling strategies, observes fueling simulation during the actual fill and analysis of vehicle storage tank. The overall project shows hydrogen as an alternative fuel, hydrogen technology as new refueling technique, safety parameters and techniques for safe refueling, initiation and advancement of hydrogen technology in context of Nepal.

Assessment for replacing coal and petroleum product with green hydrogen for steel and iron production.

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Keywords- Blast Furnaces, direct reduction method, green hydrogen.

Iron and steel industries are energy-intensive sectors and are among the top contributor to the overall anthropogenic CO₂ emissions worldwide. Conventionally, iron ore is reduced by coal or charcoal for iron and steel fabrication today. It is estimated that the production process of 1 ton of iron emits about 1.9 tons of CO₂ gas.

Hydrogen is emerging as a fuel and reducing agent for replacing coal in the iron and steel industries. Hydrogen can be produced with low carbon footprints from electrolysis and renewable electricity. In contrast to conventional carbon-based processes, the by-product of hydrogen-based reduction is water vapor. There are two ways in which hydrogen can be used in iron and steel production: auxiliary reducing agent in blast furnaces and sole reducing agent known as direct reduction method. The hydrogen-based alternative method might become competitive if the cost of hydrogen production from renewable energy is generated cheaply.

In this paper, the steel and iron production from green hydrogen is studied to contribute to developing the conceptual design along with challenges for handling the hydrogen in these industries and compared with the conventional carbon-based process. In addition, the economic assessment for the production of steel from a green hydrogen-based process.

Parametric Modeling and Optimization of Alkaline Electrolyzer For The Production of Green Hydrogen

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Keywords - Green Hydrogen, Electrolysis, Parametric Modeling, Alkaline Electrolyzer.

The decomposition of the product by passing electricity through the liquid, containing ions is electrolysis and is achieved by an electrolyzer. An alkaline electrolyzer uses electric power to break the chemical bond between hydrogen and oxygen in an alkaline electrolytic medium. The performance of the electrolyzer depends upon various parameters like temperature, pressure, ohmic overpotential, activation overpotential, etc. In this paper, various parameters that affect the performance of the electrolyzer are identified and integrated using fundamental thermodynamics and electrochemical equations. A mathematical model is created using MATLAB/SIMULINK to analyze the voltage vs current density plot of electrolyzer. An attempt is made to optimize the performance of the electrolyzer through the variation of the parameters. It was observed that increasing the operational temperature and decrease in operational pressure favors the electrolysis process. Also 30 Wt% of KOH solution as electrolyte exhibits the optimal cell voltage as compared to 30 and 40 Wt% solution.

Assessment To Replace Fossil Fuel With Green Hydrogen In Nepalese Industries To Decarbonize The Economy

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Keywords- Green House Gas, net-zero, sensitivity analysis, auto-ignition, forecasting, powertrain

Nepal is among the most prone to consequences of GHG emission due to mountainous and challenging topography and socio-economic conditions. There is a need to replace the traditional fossil-based energy supply system with sustainable and eco-friendly energy from production to end-use. The country is committed to reducing its dependence on fossil fuels and achieving net-zero emissions by 2045.

Green hydrogen, produced from renewable energy, has attracted the interest of the government and energy sector due to fewer carbon. In this paper, the possibility and effectiveness of replacing the traditional fuel in industries with green hydrogen as an energy carrier are studied with sensitivity analysis, comparison of hydrogen characteristics with fossil fuels, economic feasibility, and technical challenges. The assessments were performed on two major industries: the cement sector and the aviation sector. In the aviation sector, the Dornier-228 plane was taken as a model for the investigation. Besides, hydrogen was evaluated for heating purposes in cement industries.

Hydrogen is a viable alternative for cement industries and aviation industries. In cement industries hydrogen can be used as a combustion fuel for heating purposes, though it seems difficult to combust hydrogen alone due to its properties like high auto-ignition temperature, high adiabatic flame temperature, and low radiated heat. To fulfill the 35000 TPD coal demand in cement-related industries, which generates 83,65,00,000 MJ of thermal energy, 6,970.8 TPD of hydrogen is required. Forecasting the price of coal and hydrogen by 2025, the price of coal as USD 149.1/MT and the price of hydrogen as 1.17 USD/kg in the best-case scenario, it seems very expensive to use hydrogen in near future. In light aircraft (Dornier-228), there is a need to replace the fuel tank and powertrain for the deployment of hydrogen. Due to the nature of the hydrogen flame, the hydrogen required the assistance of a secondary flue for heating purposes.

Frequency Control Of Micro-Hydro Power Plant Using Governor And ELC.

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Keywords - micro-hydro, frequency, electronic load controller, governor

This work is responsible for the parallel mini-grid interconnection of a synchronous generator with an Electronic Load Controller (ELC) and Governor in a Micro-Hydro power plant (MHPP) so that both the generators share the common load. The study involves the development of a theoretical model for MHPP, ELC, and Governor to simulate the proposed model in MATLAB / Simulink. Frequency stability in micro-hydro plants is a major problem as system frequency fluctuates as the load keeps on changing. Therefore, in our study, the problem of regulatory frequency was investigated and the Governor and ELC were developed to address that issue. And, finally, MHPP was connected to a mini-grid. Governor using P Controller and ELC common methods have been used to control MHPP frequency. This study proposes P controllers and ELCs to improve the response time. The governor is controlled by a P controller to improve response time, while the ELC uses a phase angle control process. The ELC circuit drives the excessive current to the ballast load. The simulation result indicates that by employing the proposed frequency controllers respectively and integrating it all, the frequency and response time output of the MHPP is enhanced in load change. The simulation results of the achieved project are presented and discussed to reach a specific conclusion.

Numerical Investigation Of Flow Behaviour And Erosion Potential In The Side-Wall Clearance Between Guide Vane And Runner

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Keywords - Sediment erosion, Francis turbine, Side-wall clearance, OpenFOAM, CFD

In the hydropower plants exposed to excessive sediment concentration, the components of Francis turbines, especially the regions of Guide Vanes (GVs) and Runner Vanes (RVs) are severely eroded. The side-wall clearance between GV and runner is present in these turbines to separate the rotating and stationary components. The height difference between the runner inlet and GV outlet covers, introduced during the fabrication or assembly process might play a crucial role in accelerating the erosion process in these components. This study is focused on numerical analysis of simplified geometries that replicate different scenarios of the height difference and consequent flow behaviour in the side-wall clearance of Francis turbines. The numerical analysis is done in OpenFOAM using the available solver adopting the finite volume method (FVM). The numerical study is compared with the experimental results obtained from Rotating Disc Apparatus (RDA). The numerical analysis shows the vortex formation in the side-wall clearance region which traps the sediment particles. Such vortex formation causes erosion in the region. The vortex formation and flow behaviour in different height difference scenarios vary with each other and so does the erosion pattern in the experimental results.

Computational Study Of Sediment Erosion On Francis Blades To Study Impact Of Impingement Angle On Erosion Rate

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Keywords - Sediment erosion, CFD, Francis Turbine, Impingement angle

The rate of erosion in the Francis turbine runner blade has been examined by applying computational method. The work has been focused on the dependence of erosion rate with both the impingement angle and velocity of flow. The domain for the study is based on the single passage of runner blade of Jhimruk Hydropower Plant. Through the application of Tabakoff model to quantify the erosion, the erosion rate has been determined. Due to the nature of flow inside the passage and the shape of the blade the impingement angle varies over the surface of the specimen. The impingement angle has been computed on the surface of the flow within the domain. The domain has been subjected to CFD and purely computation study has been conducted to quantify erosion and compute the angle of impingement on the blade surface.

Design, FEM Analysis And CFD Analysis Of Traditional And Hooped Pelton Runner

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Keywords - Hydropower, Hooped Pelton Turbine, Finite Element Method, Computational Fluid Dynamics.

The buckets of a turbine experience repetitive load from water jet causing fatigue, which leads to repair by welding, followed by thermal treatments, and these operations leaves strains on the base material, and hence complete replacement of the runners. Hooped runner allows a better distribution of forces. Hooped runner is intended to achieve easy maintenance - the separation of bucket and hoop from runner itself facilitates the assembly process, and makes components easy to replace in case of failure. This reduces the stresses due to its construction in supplying the bucket as simply supported embedded beams. Based on the observation of officially registered patents, the Computer Aided Design of hooped Pelton turbine was prepared. Finite Element Analysis (FEA) showed that equivalent stress was reduced by 81% in hooped Pelton runner compared to the traditional runner. Also, the structural deformation in hooped Pelton runner was reduced by almost 92% compared to the traditional Pelton runner. However, installing the hoop can negatively obstruct the flow of fluid, which can result in reduced efficiency. Preliminary Computational Fluid Dynamics (CFD) analysis showed that hoop obstructs the flow of fluid, although both traditional and hooped Pelton runner produced similar torque in given setting. Also, the cavitation-prone zone was found on the inner side of hoop. A detailed study is required to assess the efficiency of traditional and hooped Pelton runner.

Relative Assessment of Carbon Emission from Fossil Fuel-based Vehicles, Battery Electric Vehicles, and Fuel Cell Electric Vehicles.

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Keywords - carbon emission, carbon footprint, battery-electric vehicle, fuel cell electric vehicle

Carbon emission from fossil fuel consumption has been a global concern with a rise in carbon dioxide content by 6.75% in the atmosphere from 390.1 ppm in 2010. Fossil fuel consumption resulted in 34 Gt of carbon emission only in the year 2020 of which the transportation sector shared one-fifth of the emission with consumption of 29% of the fuel. Fossil fuel-based vehicles account for a major share of carbon emissions establishing a need for an alternative path for low carbon emission transportation. The emission associated with fossil fuel vehicles is direct emission from the burning of fossil fuel and indirect emission from the crude oil emission, tailpipe emission, and manufacturing emissions. The energy transition from fossil fuel-based vehicles to alternative means has technologically advanced research direction in battery electric vehicles (BEVs). BEVs have a greater carbon emission than conventional fossil fuel-based vehicles during manufacture due to the large battery pack. There is no direct emission in BEVs and indirect emission is only from the battery charging. Hydrogen-based fuel cell electric vehicles (FCEVs) have also come along as a substitute for fossil fuel-based transportation for low carbon emissions. FCEVs have a carbon emission more than conventional IC engine vehicles and less than BEVs during manufacture due to the smaller size of the battery pack. They have very less carbon emission from indirect sources associated with carbon emission during hydrogen production. The paper includes a relative assessment of carbon emission from conventional IC engine vehicles, BEVs, and FCEVs.

Demonstrative Model Of Solar Pv Based Water Heating And Circulating System

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Keywords- PV, solar energy, alternative energy, water heating, steam generation.

Solar thermal and PV energy is a promising alternative energy source for water heating for residential, non-residential, and industrial uses. Solar energy can replace coal, diesel, and gas for applications such as water heating and steam generation. In this study, solar PV panel for water heating are proposed. A model is developed to demonstrate the use of solar PV for water heating. After fabrication of the model, testing will be performed and changes would be made accordingly to its utmost efficiency. While testing, various parameters like temperature difference, hours of exposure of PV panel in the sunlight and efficiency will be accounted. The system is designed and built-in following energy requirements, solar radiation available, customer's preferred temperature, geographical location, and other important factors. The demonstration model is small in size and power, but can be scaled up to a large system. It is academically useful in understanding the fundamentals and applications of solar energy. The model can be used in experimental purpose and is expected to have lower operating cost. It can be used to illustrate the conversion of solar energy into heat and mechanical energy.

Status Review Of Solar Water Heaters In Nepal

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Keywords - Solar Water Heater, Nepal, Thermosyphon, Evacuated Vacuum Tubes, Flat plate

Solar Water Heating (SWH) system in Nepal is a growing trend for heating water besides the use of electricity (32%). With over 4.5 kWh of average solar irradiance endowed per square meter of collector every day, this solar energy supply exceeds the average demand of daily water heating energy (2.8 kWh) in any Nepali household, which is why SWH systems are getting more attention as cost saving heating alternatives. But, the lack of uniformity, safety protocols and performance effectiveness in product handling points toward the requirement of standardization and certified recognition of Solar Water Heating systems. The primary objective of this research is to understand the environment SWH systems work in, and determine mandatory domains that influence the standardization of SWH systems in Nepal. The method identified for this work will be done in two phases a) archival study for investigation of existing international certifications and test conditions and b) social survey for status review of Nepalese market. The paper also discusses the current status of SWH systems in terms of Nepal's socio-economic context and talks about the necessity of standardization protocol from governmental level based on social and scientific experimentation.

Barriers Of Recycling Of Battery In Nepal

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Keywords - Lithium ion, Lead acid, Barrier, Electrical Vehicle, Recycle

Battery Technology is extensive in the individual consumers and in scaled operation, be it through the use of smartphones, automotive vehicles or various other devices. In recent years, electrification of vehicles has been the topic of discussion in automobile and manufacturing industries. A normal lithium-ion battery has a life cycle of around 10-20 years, after that the battery starts to deteriorate in performance and has to be replaced. Whereas a lead acid battery has even low performance that is 3-5 years on average. The factors that affect batteries are time, temperature and cycle life. In the past 10 years the growth rate of vehicles in Nepal has exceeded 16% per annum and the number of registered vehicles is 3.5 million, in which over 90% are passenger vehicles while only 10% are freight and other vehicles. Most of the EV uses lithium-ion batteries while normal petrol and diesel vehicles use lead acid batteries for starting up the motor or other electronic systems, so all of the vehicle uses some kind of batteries. The census of 2077/78 shows 42,436,952 numbers of batteries being imported including primary batteries, lead acid and lithium-ion batteries, and majority number of batteries being imported are from China, India, Bangladesh and Japan. As the market grows there will be wastage or after a certain number of use batteries have to be replaced so, those batteries we can either reuse or recycle them. The scope of the paper is to identify the barriers for recycling of batteries in Nepal. Sixteen barriers are identified and categorized into four major challenges: Technical, Commercialization, Policy and Regulation and Awareness. For a rapidly growing country such as Nepal we can expect rapid growth in technologies also, and ultimately e-waste, so in order to regulate such e-waste policies and regulations should be made timely.

Techno-economic Analysis of Energy Systems in Thakle Namuna Basti- A Case Study

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Keywords - HOMER PRO, Techno-economic Analysis, DUDBC, NPC, LCOE

The electrical supply system in most underdeveloped nations is incredibly undependable. The country's existing distribution system has experienced regular power outages due to population growth, industrial expansion, rough terrain, and a long-distance transmission network. The conventional approach to centralized generation and transmission is failing to address this challenge and as a response, the utilization of renewable energy sources is expanding day by day to alleviate the energy crisis. The purpose of this study is to perform a techno-economic analysis and optimization of a 100% renewable off-grid and on-grid hybrid energy system for the electrification of Thakle Namuna Basti, a small communal village in Melamchi, Sindhupalchok. The HOMER Pro (trial version) program is used to analyze available data as an input to determine the economic feasibility of the suggested hybrid power system. All the available resources are provided as an input parameter along with load data and Homer Pro optimizes the outcomes for that specific site based on NPC, LCOE, operating cost, load variability, pricing, and meteorological data from the study locations, and so on. The system is designed to meet the capacity of at least 85,000 kWh/yr. In addition, sensitivity analysis is performed for the proposed HES system using the flow rate, price of electricity, etc. Finding out the best system architecture based on various economic parameters along with the energy consumption pattern of that community for both on-grid and off-grid systems will be the main findings of the project. This research also focuses on how to ensure a consistent supply of resources that are both cost-effective and environmentally beneficial.

Stove Maturity Status Review

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Keywords- Consumption, Stove, Fuel, Efficiency, Installation

Bypassing the traditional cooking stove with an improved cooking system (ICS) is minimizing fuel consumption, health hazards, and operational cost. Moreover, impacting the social-economical aspect of a country. The paper provides the status of Improved cooking stoves, Policy, and impact and effects on the use of alternatives which is achieved through archival study and survey. The government emphasizes rural energy policy including a Hydropower development policy, Renewable energy subsidy policy, Renewable Energy Capacity Needs Assessment for Nepal (2016), and a Biomass energy strategy that focuses on improving cooking standards. The government proposed a metallic ICS model, Institutional ICS, and Rocket stoves for the cooking maturity along with subsidy. The possibility of adopting improved cooking over the traditional stove all depends on the cost of manufacturing, use of resources, transportability, and manufacturability on-site as well as subsidy provided for mass production and distribution. By 2019 Government initially distributed around 425,511 household biogas systems, 247 institutional and community biogas plants 1,423,242 mud improved cookstoves and 85,805 metallic improved cookstoves have been installed through AEPC. To promote electric cooking, AEPC plans to distribute electric stoves to a student studying in Kathmandu. Now government focuses on power sector policy, The Subsidy Delivery Mechanism for Renewable Energy 2016, The biomass energy strategy, federal periodic plans, Nationally Determined Contributions (NDC), Biomass energy strategy, etc. that enable the environment of induction cooking system. Even though Nepal intends to use electric stoves, over ICS there are various factors that as of now Nepal cannot subsidize. Frequent power outages, National grid line sustainability reduce reliance on electric cooking.

Design And Analysis Of Low Temperature Refrigeration System

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Keywords - Refrigeration, LTRS, Cold Room, Refrigerant, Cycle Design, EES

Cascade refrigeration system engages series of single stage vapor compression units thermally coupled at evaporator of high temperature circuit and condenser of low temperature circuit. Recently recovering from one of the severe pandemics, highlights has been on the pharmaceutical companies and its requirement of ultra-low temperatures -80°C or greater for vaccines and other purposes. So, purpose of this research paper is to provide ideal design of LTRS including thermofluidic mechanism of each and every component. System design was done using EES. First enthalpy pressure, temperature at every stage of the cycle, heat rejected and added through the condenser and evaporator respectively, work done, COP is calculated. Then the total load calculation in evaporator section is done along with finding the size of a compressor using mass flow rate, evaporator load, enthalpy change. At last condenser and evaporator length and diameter and length of throttle valve is calculated. SOLIDWORKS is tentatively used to design the refrigerated space in accordance to data of product which is going to be stored. Refrigerants on both circuits are selected accounting availability, safety, cost and sustainability. With this research refrigeration circuit with further lower temperatures, environment friendly refrigeration system can be made in the future and its application broadens to metallurgical testing, biological storage and so on. Moreover, literature review in refrigeration, cascade refrigeration cycle, LTRS, numerical analysis, conceptual framework, study design process is defined.

Flow And Structural Analysis On Bifurcation Of Upper Hewa Hydro-power Project (8.5 Mw)

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Keywords -Bifurcation, Fluid Structure Interaction, Computational Fluid Dynamics, Finite Element Method

Bifurcation of Penstock in the hydropower plant is used to divide the flow into the two units for power generation. The penstock branching manifold is subjected to high pressure and therefore considered as the most critical part of the hydropower project. This study aims to find the most efficient flow and thickness of bifurcation in given constraints of pressure, velocity and layout of the overall geometry. The study is done for Upper Hewa Hydropower Project (8.5 MW) of Sankhuwasabha District, Nepal. A general profile and the flow pattern inside the bifurcation is estimated using CFD. The angle between the bifurcating pipes is selected based on minimum loss in the bifurcated section. The pressure field developed on the walls of the pipes are exported to FEM analysis to carry out a one way (FSI) fluid structure interaction. The optimum thickness of the pipe and reinforcements are provided from the FEM analysis, which incorporates sufficient factor of safety to withstand the water hammer pressure. The result of stress and deformation will then be observed and checked against the prevailing codes.



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The **Nepal Hydrogen Initiative (NHI)** is a consolidated program to establish the policy foundations, develop an implementation action plan, and incubate a value chain for the business development with Green Hydrogen as the driving force to address the existing and upcoming challenges of the environment, fuel, energy, economy, and industrial development in Nepal. At present, NHI is an entity of Kathmandu University and is conceived to be owned by Nepal Government in future.

Contributing to '**Carbon Neutral and Energy Independent Nepal**'.

Green Hydrogen for Ammonia Production.



Green Hydrogen for Industrial Heat.



Green Hydrogen for zero-emission Transportation.



Green Hydrogen for Re-electrification.



Green Hydrogen for Steel and Mining.



Mission

Reduction in fossil based fuel consumption and greenhouse gas emissions, and contribute to more secure and efficient industrial processes by enabling the commercialization of green hydrogen technologies in Nepal.

Showcase Projects

Targets



Vision

Transformation of Nepalese Economy and Society by enabling the sustainable and affordable Green Hydrogen Technologies from the available renewable energy resources.

Phase-I: 2021-2025= Inception phase



Phase-II: 2025-2030= Commercialization



Phase-III: 2030-2040= Global Presence



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