Course Brochure

Global Initiative of Academic Networks (GIAN)
International GIAN Course – 2024
on

Mini-Hydro Power Plant Design and Integration with DC Microgrid (MHPDIMG-2024)

November 18-22, 2024

Organized by

Department of Electrical Engineering
National Institute of Technology Rourkela,
Rourkela, India-769008

Course Coordinator(s):

Dr. Monalisa Pattnaik	**:** Course Coordinator
Dr. Indrajit Sarkar	**:** Course Coordinator
Prof. Shishir Kumar Sahu	**:** Local GIAN Coordinator

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Overview

The global Energy Strategy 2050 (ES2050) has set ambitious goals in terms of renewable energy penetration and CO_2 emission reduction. Among many sources of renewable energy, hydropower has the oldest history. However, the large hydro power plants with storage reservoirs are no longer considered environmentally friendly due to impact on the downstream ecological systems. In this respect, run of river type mini-hydro power plants (MHPs) are considered eco-friendly and in all parts of the world they are economically viable. Their intermittency is very low compared to wind or solar power plants and therefore preferred for development.

Meanwhile, microgrids with renewable energy sources and battery storage have gained worldwide momentum and are implemented in many countries for different purposes. The main purpose of a microgrid is to provide reliable and affordable energy to a specific area or community while reducing the reliance on the conventional grid. DC microgrids (DCMG) have their own advantages and have various applications over AC microgrids. Typically, distributed energy resources (DERs) like photovoltaic systems function within the DC framework. However, it introduces power fluctuations into the DC network due to their unpredictable and varying solar radiation and temperature conditions. To mitigate this issue, the integration of mini hydro-power plant will be viable due to its low intermittency. Furthermore, the purpose of this integration is to leverage the MHP's capability for production forecasting, thereby enhancing the reliability of power generation. Additionally, use of MHP has the added advantage of minimal environmental impact compared to other types of DERs. In this context, the course is well designed in coherence with ES 2050 goals to impart the research knowledge about developments of MHP based DC microgrid starting from the fundamentals to practical demonstrations with clear objectives mentioned below. The course will also provide an ample opportunity for the participants to interact with the expert throughout the course.

Objectives

The primary objectives of the course are as follows:

1. To be able to identify potential sites for the development of mini-hydro power plants
2. To impart the ability to do the basic design of a mini-hydro power plant up to 10 MW capacity
3. Ability to design and develop electrical systems for mini-hydro power plant for microgrid
4. To understand the importance of the pivotal component of the DC microgrid and ability to integrate power electronic converters with renewable energy sources
5. Enhancing the capability of the participants to select, size and operate a battery storage system
6. Providing exposure to practical problems and their solutions, through experimental demonstrations and case studies

Teaching Faculty

1. **Prof. Anura Wijayapala -** Professor and Head of the Department in Department of Electrical, Engineering, University of Moratuwa, Sri Lanka.
2. **Dr. Monalisa Pattnaik** - Associate Professor, Department of Electrical Engineering, NIT Rourkela
3. **Dr. Indrajit Sarkar** – Assistant Professor, Department of Electrical Engineering, NIT Rourkela

Lecture Schedule: November 18-22, 2024

The course is divided into lectures, tutorials, simulation and demonstration modules as follows:

A. 26 Lectures of 30 mins each with following brief details:

Lecture 1,2: Introduction to mini-hydro power and use of contour maps
Lecture 3, 4: Identification of hydro power development opportunities and locating the diversion weir for a given project
Lecture 5, 6: Design of the hydraulic canal and desilting basins
Lecture 7, 8: Design of forebay tank and penstock part-1
Lecture 9, 10: Design of penstock part-2 and design of anchors for the penstock
Lecture 11, 12: Basic hydrological study and development of a flow duration curve (FDC)
Lecture 13, 14: Use of FDC to determine the rated flow and types of hydro power turbines part-1
Lecture 15, 16: Types of hydro power turbines part-2 and power generated from a hydro power scheme
Lecture 17, 18: Calculation of energy generation from a mini-hydro power plant part-1 and part-2
Lecture 19, 20: Water level sensor for the forebay tank and controller for the needle valve/wicket gate operation
Lecture 21, 22: Electrical system of a mini-hydro power plant part-1 and part-2
Lecture 23, 24: Single line diagram and optimum operation of the power plant
Lecture 25: Overview of microgrid, sizing analysis of energy storage system, design
Lecture 26: Dual active bridge (DAB) dc-dc converter, it's modulation techniques

B. 8 Tutorials/hands on training of 1 hour each with following brief details:

Tutorial 1: Design and simulation of power converter used in battery energy storage system
Tutorial 2,3: Power electronics interfaces in microgrid applications and converters for mini-hydro power plant and it's simulation study
Tutorial 4,5 : Design of a mini-hydro power plant for a given location
Tutorial 6,7: Power management in DC microgrid and it's demonstration
Tutorial 8: Experimental demonstration of DAB converter operation

Evaluation

Participants will be evaluated through Assignments/Quiz. After successful completion of the course, all participants will get participation certificate. GIAN course details are available in national GIAN portal **(https://gian.iith.ac.in/)**.

Number of participants attending this course in-person will be limited to Forty (40)

Prospective Participants

- Students at all levels (BTech /MTech/PhD) and researchers, faculty members in all areas of Electrical Engineering, power and energy systems and applications
- Engineers from industries and R&D laboratories from all areas of engineering working on power and energy systems and applications.

Registration Process & Fees

First, the participants have to do the mandatory registration in the Google form link given below. After scrutiny of the registered participants, maximum 40 participants will be notified through email for the registration fee payment. The registration fees (***non-refundable***) for participating in the course are as follows:

Category	Registration Fee (Excluding GST)
Students (Research Scholars/ PG / UG (3rd year onwards))	**: INR 1000/-**
Faculty/Researchers from Academic/Research Institutions	**: INR 2000/-**
Participants from Industry	**: INR 5000/-**
Participants from abroad	**: USD 300/-**

Registration fee for students / staffs of NIT Rourkela is nil.

Registration fee (***after receiving email confirmation***) can be directly deposited to **Account No: 10138951784, Account Name: CONTINUING EDUCATION NIT ROURKELA, IFSC No: SBIN0002109**, Branch: State Bank of India, NIT Campus Rourkela.

Online Registration Form (for external participants): https://forms.gle/HVLyAHBXFF8nikGw8

No TA, DA will be provided to the participants. Participants have to arrange their own accommodation and food. *However, limited shared accommodation may be made available (subject to availability) in the Institute Guesthouse/ Guest Rooms of Hostels on request on first come first serve basis. Payment for accommodation & food is extra as per actuals.*

Last Date of Registration: October 31, 2024

About the Institute:

National Institute of Technology Rourkela (NITR) has a diversified academic program with 17 academic departments offering specialized courses at undergraduate, postgraduate and doctoral levels of studies. The Institute currently offers 21 undergraduate programs in the major disciplines of engineering, architecture, science, humanities and management, and post graduate programs in diversified fields of research areas. While the academic programs offered by NIT Rourkela are in tune with the National Education Policy, the quality of education is continuously upgraded by periodical revision of syllabi based on the needs of industry and academia. With different inclusive initiatives and the introduction of a standardized education policy, over the years, the Institute's graduates have been great performers at professional fronts in India and abroad. With the focus on teaching and learning across departmental boundaries, the mix-technology and management skills, NITians have been valuable assets to our country. Today, NIT Rourkela is a highly prestigious institute with a reputation for excellence in research, consultancy and education at undergraduate, postgraduate and doctoral levels. It is passionately committed to making our country a world leader in technology and science and to inculcate this commitment among all its students. Our target is to be known around the world for our academic standards and to be counted among the best technological institutes of India in terms of innovation, entrepreneurship and creation of intellectual wealth. **Please visit: https://www.nitrkl.ac.in/**

37 NIRF Overall	**16 NIRF Engg.**	**29 NIRF Research**	**281-290 QS Asia**

About the Department

The course will be organized by the Department of Electrical Engineering, NIT Rourkela. The department of Electrical Engineering is established with the vision to design technologies and nurture technologists for diverse and sustainable growth in electrical engineering, leading to wealth and welfare of humanity. The department offers various UG, PG and PhD programmes with the mission to develop a platform for forging students as technocrats in line with cutting-edge academic, research and modern industrial practices, and enhancing their aptness in any technical sectors across the globe. **Please visit: https://website.nitrkl.ac.in/EE/**

How to reach NIT Rourkela

The Institute is located at about 7 km from the Rourkela railway station. Autos/taxis are available round the clock there. Local transport facility is also available from nearby private bus terminus. The Howrah-Mumbai line and Ranchi-Bhubaneswar line passes through this city. Major airports in the proximity of Rourkela are Jharsuguda, Ranchi, and Bhubaneswar.

Brief CV of Experts

Prof. Anura Wijayapala is an Electrical Engineer graduated from University of Moratuwa, Sri Lanka, in 1991. He served in the private sector electrical engineering industry for 15 years before joining as a Senior Lecturer at the Department of Electrical Engineering of University of Moratuwa in year 2006. He obtained his Master of Engineering Degree in the year 2001 from University Moratuwa. He has been a Chartered Electrical Engineer since 1996 and he is a Fellow of the Institution of Engineers, Sri Lanka and an International Professional Engineer. He has served as Chairmen of Ceylon Electricity Board, NERD Center and LTL Holdings Pvt Ltd. On sabbatical leave from the University, he served as CEO of Wind Force Pvt Ltd from February 2018 to February 2020. Currently he is a Professor and Head of the Department in the Department of Electrical Engineering, University of Moratuwa, Sri Lanka.

Prof. Monalisa Pattnaik received her B.Tech. degree in Electrical Engineering from the College of Engineering and Technology, Orissa University of Agriculture and Technology, Bhubaneswar, India, in 1999. She received her M.Tech. and Ph.D. degree from Indian Institute of Technology Kharagpur, India, in 2006 and 2013 respectively. Dr. Pattnaik is a recipient of the POSOCO Power System Award, Power Grid Corporation of India Ltd., India, in 2013. She joined as an Assistant Professor in the Department of Electrical Engineering, National Institute of Technology Rourkela in 2012 and is currently serving as an Associate Professor. Her prime areas of teaching and research include Wind and Solar Energy System, Hybrid Electric Vehicle, Efficient Power Management of Hybrid Energy Systems, Grid Integration issues of RES, Machine Drives and Power Electronics. Dr. Pattnaik has published 18 journals, 30 conference papers, and 5 book chapters excluding the publication during her PhD.

Dr. Indrajit Sarkar received his Ph.D. degree in Electrical Engineering from IIT Bombay in 2018. He has nearly 7 years of industrial experience working in the area of power electronic converters are control. His areas of research interest are EV battery charging systems, grid-connected solar converters, DAB and TAB isolated DC/DC converters, multilevel converters, control of power converters etc. He completed his B.E. in Electrical Engineering and M.E in power electronics and drives specialization from IIEST Shibpur in 2005 and 2012 respectively. From Aug 2005 - Jun 2010, he served as an engineering graduate in ITES in the Energy and Utility vertical at Tata Consultancy Services Ltd., Kolkata. From 2012 to 2017, he was a full-time Research Scholar at the Department of Electrical Engineering, IIT Bombay. From 2017-2019, he has served as R&D Engineer in HVDC Grid System at ABB Global Industries Service Ltd., India. In July 2019 he joined as an assistant professor in the Department of Electrical Engineering MNIT Allahabad. Dr. Sarkar joined the Department of Electrical Engineering of NIT Rourkela in March 2020, where he is currently serving as Assistant Professor.

Contact Details:

Course Coordinator
Dr. Monalisa Pattnaik
Associate Professor
Department of Electrical Engineering
National Institute of Technology Rourkela
Rourkela, India -769008
Ph: 0661-2462423 (O), +91-8895381976(M)
Email: pattnaikm@nitrkl.ac.in

Course Coordinator
Dr. Indrajit Sarkar
Assistant Professor
Department of Electrical Engineering
National Institute of Technology Rourkela
Rourkela, India -769008
Ph: 0661-2462416 (O), +91-9167482002 (M)
Email: sarkari@nitrkl.ac.in

Local GIAN Coordinator
Prof. Shishir Kumar Sahu
Professor, HAG
Department of Civil Engineering,
National Institute of Technology Rourkela
Rourkela, India -769008
Ph: 0661-2462322 (O), +91-7978705849 (M)
Email: sksahu@nitrkl.ac.in