RENEWABLE ENERGY (1st Batch)
Course Module with Proposed Resource Persons
Schedule: 12- 23 April 2026

Sl	Topic	Resource Person
01	**Module 1: Renewable Energy Technologies (02 hours)** • **Introduction to Renewable Energy:** Global energy landscape, Need for renewables, Sustainable Development Goals (SDGs), and sustainability goals. • **Solar and Wind Energy:** Basics of solar photovoltaic (PV) systems, wind turbine mechanics, and system components. • **Solar Thermal systems:** Types of solar thermal collectors, solar air heater, solar cooker, solar desalination systems, solar dryer. • **Hydro and Biomass Energy:** Micro and macro hydropower systems, biomass-to-energy pathways; • **Bioenergy:** Types of fuel cell, Microbial fuel cell (MFC), microbial electrolysis cell (MEC), types of MFC, biogas systems. • **Agri-solar systems:** Hydroponic and Aquaponics systems. • **Energy Storage and Grid Integration:** Battery types, renewable energy storage technology, grid-tied vs. off-grid systems, solar-based Hydrogen storage technology. • Hydrogen Green Technology and green ammonia • **Case Study Session:** Examples from Bangladesh and global models.	1. **Dr. Nasif shams** Associate Professor Institute of Energy, University of Dhaka 2. **Professor Dr Mohammad Matin** Denver University, USA
02	**Module 2: Solar Energy Systems (08 hours)** **Class 01** • **Introduction to Solar Energy:** Status of renewable energy sources, importance and potential of solar energy in Bangladesh. • **Solar Radiation and Resource Assessment in Bangladesh:** Fundamentals of solar radiation, a detailed understanding of sunlight as an energy source, and measurement techniques. Geographic and seasonal variations in solar energy availability in Bangladesh. Global trends in solar technology, Bangladesh's current energy scenario, government policies, and initiatives promoting solar energy. • **Semiconductor Fundamentals and Basics of Solar Photovoltaics (PV):** History of solar cell technology, generations of solar cells, semiconductor materials specifically used in solar photovoltaics, mechanism of electron-hole pair generation and recombination in semiconductors, carrier injections in photovoltaic p-n junctions. **Class 02** • **Solar Photovoltaic (PV) Characteristics:** Basic principles and working mechanism of solar cells, differentiating between dark and illuminated characteristics of solar cells, explanation of solar cell output parameters, efficiency limits, and measurement methods. • **Solar PV Components and Equipment:** Inverter Technologies for Renewable Energy Systems: o Role of inverters in renewable energy systems o Classification of inverters: Central inverters o String inverters o Microinverters o Power optimisers	1. **Professor Dr Mohammad Matin** Denver University, USA 2. **Dr. Nasif shams** Associate Professor Institute of Energy, University of Dhaka

	○ Single-phase vs three-phase inverters ○ Grid-forming and Grid-following inverters ○ Grid-tied, off-grid, and hybrid inverters: Operating principles ○ Application scenarios in Bangladesh ○ Key inverter functions: Maximum Power Point Tracking (MPPT) ○ DC–AC conversion ○ Anti-islanding protection ○ Reactive power control (Volt-VAR) ○ Inverter efficiency, derating, and thermal management ○ Harmonics and power quality issues related to inverters ○ Inverter protection features: Over/under voltage ○ Over/under frequency ○ Ground fault and arc fault protection ○ Communication and monitoring: SCADA readiness ○ Data logging and remote monitoring ○ Grid code compliance (introductory): LVRT/HVRT concepts ○ Reactive power requirements ○ Selection criteria for inverters: System size ○ Climate conditions (temperature, humidity) ○ Grid conditions in Bangladesh • **Off-Grid and On-Grid Solar Systems:** Off-grid solar systems: standalone solutions, on-grid solar systems: feeding power to the national grid, pros, and cons of each system in the context of Bangladesh. **Class 03** • **Transparent Solar Panels:** Basics of the Transparent Solar Cells, Potential Impact and Developments of Transparent Solar Cells, Brief Discussion on Transparent Solar Panels, Impacts of Transparent Solar Panels over Traditional Solar Panels, Future Aspect of Transparent Solar Panels. • **Operation of Solar PV Systems Running in Bangladesh:** Solar parks, rooftop solar, solar irrigation, solar home system (SHS), solar mini-grid, solar streetlights, solar-powered telecom BTS, and solar charging stations. • **Maintenance of Solar Systems:** Importance of regular maintenance for optimal performance. Troubleshooting common issues in solar systems. **Class 04** • **Modern Solar Thermal Energy System:** Principles of solar thermal energy conversion, different types of solar collectors (flat plate, concentrating collectors), solar thermal energy storage system, applications of solar thermal energy in heating water, space heating, air conditioning, and industrial processes. An overview of concentrating solar power (CSP) generation systems and their working principles. • **Solar Energy Projects and Sustainable Development Goals (SDGs) in Bangladesh:** Case studies of successful solar energy projects in Bangladesh, Overview of applications of solar energy in rural electrification, agriculture, and industries, the contribution of solar energy towards sustainable development, addressing energy	

	access and environmental concerns. • **Challenges and Solutions in Solar Energy Implementation:** Common challenges faced in implementing solar projects, solutions, and strategies to overcome barriers.	
03	**Module 3: Wind Energy Systems (06 hours)** **Class 01** • Climate change, Global potential for wind-generated electricity and the worldwide growth of the wind turbine industry, both onshore and offshore • Estimation of wind energy potential and prediction of wind power • Wind turbine technologies: Turbine classifications, wind turbine components, Contemporary wind turbine technologies **Class 02** • Economics of wind energy and certification issues • Reliability of wind turbines • Wind farm layout and landscape **Class 03** • Engineering aspects of a wind farm and wind turbine structures, including foundation design technologies • Grid integration of wind power: Smart grid and energy storage • Achieving carbon neutrality using wind energy systems: Case study of wind energy development in EU / China / India or other relevant countries	1. **Captain Md Moyezuddin**, BN (Retd) 2. **Farhana Arzu** Asst. Professor Naval Architecture and Offshore Engineering, BMU

04	**Module 4: Wave Energy Systems (04 hours)**
	Class 01:
	Renewable Ocean Energy
	This module introduces ocean-based renewable energy sources, emphasising their potential, advantages, and challenges. Key Topics:
	• Overview of Renewable Ocean Energy Sources
	  o Wave Energy: Harnessing wave motion for electricity generation
	  o Tidal Energy: Utilising tidal currents and tidal range
	  o Ocean Thermal Energy Conversion (OTEC): Using temperature gradients
	  o Salinity Gradient Power: Energy from differences in salinity
	• Global Potential and Market Trends
	  o Countries leading in ocean energy development
	  o Policies and incentives for marine renewables
	• Challenges and Future Prospects
	  o Technological barriers and environmental concerns
	  o Grid integration and economic viability
	
	Wave Energy Conversion, Storage, and Performance
	This module explores wave energy extraction technologies, storage methods, and performance optimisation.
	• Wave Energy Conversion Technologies
	  o Point absorbers, attenuators, oscillating water columns
	  o Floating vs. fixed wave energy converters
	• Energy Storage for Wave Power
	  o Batteries, supercapacitors, and hydrogen storage
	  o Grid integration challenges
		1. **Captain Md Moyezuddin**, BN (Retd)
		
		2. **Dr. Rashidul Hasan**
		Asst. Professor
		Naval Architecture and Offshore Engineering, BMU

	• Performance Evaluation and Optimisation
	  o Efficiency metrics for wave energy converters (WECs)
	  o Impact of wave climate on power generation
	Marine Current Conversion: Tidal Resource, Tidal Devices, and Practical Resource
	This module covers the principles of marine current energy, tidal energy technologies, and resource assessment.
	• Understanding Tidal Energy Resources
	  o Types: tidal range vs. tidal current energy
	  o Global tidal energy hotspots
	• Tidal Energy Conversion Devices
	  o Horizontal-axis and vertical-axis turbines
	  o Tidal barrages and dynamic tidal power
	• Practical Considerations in Tidal Energy Deployment
	  o Environmental and navigational impacts
	  o Maintenance challenges in harsh marine environments
	
	<u>Class 02</u>
	Tidal Phasing
	This module introduces tidal cycles, phase differences, and their impact on energy generation.
	• Tidal Dynamics and Energy Availability
	  o Spring-neap cycle and daily tidal variations
	  o Phase differences across multiple tidal sites
	• Grid Integration of Tidal Power
	  o Smoothing variability through tidal phase balancing
	  o Coordinated energy production from multiple sites
	• Case Studies of Tidal Phasing Optimisation
	  o Real-world examples of phase balancing for energy reliability
	
	Ocean Thermal Energy Conversion (OTEC) Systems: Applicability, Thermodynamics, Design Challenges
	This module focuses on the principles of OTEC, its potential, and the challenges in system design.
	• Principles of OTEC
	  o Using ocean temperature gradients for power generation
	  o Open-cycle vs. closed-cycle OTEC systems
	• Design and Deployment Challenges
	  o Deep-sea infrastructure and material durability
	  o Economic feasibility and environmental impact
	
	Wave Energy Converters, Floating Devices, Oscillating Water Column, Optimal Hydrodynamic Performance
	
	This module explores different wave energy converter (WEC) types and their hydrodynamic performance.
	• Types of Wave Energy Converters
	  o Point absorbers, oscillating wave surge converters, and overtopping devices
	  o Floating vs. fixed WECs
	• Oscillating Water Column (OWC) Systems	

	○ Working principle and efficiency factors ○ Examples of OWC power plants • Optimal Hydrodynamic Performance ○ Numerical modelling and CFD simulations for WECs ○ Wave-structure interactions and power capture optimisation	
05	**Module 5: Hydropower (02 hours)** • Functions and classifications of the typologies of hydropower systems and main components. • Overview of micro, mini and small hydropower systems, layouts for each type and capacity computation. • Water conveyance structure, Hydroelectric plants with reservoir and run-of-the-river plants. • Overview of Hydraulic control systems in Hydropower Plant. • Study of typical Hydraulic circuits used in Hydropower applications, such as: – Turbine governor control (Pelton, Kaplan, Francis and Bulb types) – Main Inlet Valve (MIV) control – Dam gate control – Generator lubrication systems, etc. • Application of Electro-Hydraulic Proportional & Servo Valve in Hydropower Plant. • Hydropower potential, status and development in Bangladesh. • Selection of site and design criteria of pumps and turbines, fuel cells, etc. • Load prediction demand assessment, classification and types of hydropower development. • Operations management, Maintenance & Troubleshooting of Hydraulic systems used in the Hydropower Plant. • Cross-border Hydropower transmission between Bangladesh and other South Asian Countries.	1. **Dr. Sania Binte Mahtab** Assistant Professor BUET 2. **Dr. Ataur Rahman** Professor Water Resource Engineering, BUET
06	**Module 6: Energy Storage System (02 hours)** • Need for storage of renewable energy and Key characteristics for grid-scale energy storage. • Mechanical Energy Storage Technologies: Pumped hydro storage (PHS), Compressed air energy storage (CAES). • Thermal Energy Storage Technologies: Sensible heat storage, Latent heat storage. • Electrochemical Storage Technologies: lithium-ion (Li-Ion), Sodium Sulfur (NaS), lead-acid (Pb-Acid), vanadium redox flow batteries (VRB). • Supercapacitors and comparison of energy storage technologies • Supply demand analysis • Energy Modelling	1. **Iftekharul Islam** Emon Assistant Professor BUET 2. **Captain Md Moyezuddin**, BN (Retd)
07	**Module 7: Environmental and Social Impacts of Renewable Energy (02 hours)** • **Introduction to Environmental and Social Impacts of Renewable Energy** Overview of renewable energy sources (solar, wind, hydro,	1. **Dr. Nasif shams** Associate Professor Institute of Energy Institutes, University of Dhaka

	bioenergy, marine, geothermal). Positive and negative environmental impacts. Social benefits and challenges of renewable energy adoption. Role of international organisations and policy frameworks (UN SDGs, IRENA, IPCC). • **Environmental Impact Assessment (EIA) and Strategic Environmental Assessment (SEA)** 1. Introduction to Environmental Impact Assessment (EIA). 2. Strategic Environmental Assessment (SEA) for large-scale energy projects. 3. Legal and regulatory frameworks governing EIA. 4. Case studies of EIA in solar, wind, and hydropower projects. • **Climate Change Mitigation and Renewable Energy** 1. Role of renewables in reducing fossil fuel dependency. 2. Carbon lifecycle analysis of renewable energy systems. 3. Climate adaptation strategies in renewable energy planning. 4. Global climate policies (Paris Agreement, COP discussions). • **Strategies for Minimising Environmental and Social Impacts** 1. Green design and circular economy approaches. 2. Community participation models in energy planning. 3. Wildlife-friendly infrastructure solutions. 4. Offshore wind, hydropower, and solar farm best practices.	2. **Captain Md Moyezuddin**, BN (Retd)
08	**Module 8: Renewable Energy Policy and Economics (04 hours)** **<u>Class 01</u>** • **Introduction & Policy Frameworks:** o Sustainable And Renewable Energy Development Authority (SREDA), o Sustainable Development Goals **(**SDG) 7, o National Renewable Energy Policy 2025 (Bangladesh), o Power System Master Plan (PSMP) 2016, o Energy Efficiency and Conservation Master Plan up to (EECMP) 2016, o Global Standards Management Process (GSMP) 2017, o Bangladesh Delta Plan 2100, o Nationally Determined Contributions 2021 Bangladesh (NDC 2021), o Perspective Plan of Bangladesh 2021-2024, o International Renewable Energy Agency (IRENA) guidelines, policy and regularity of the Blue Economy of Bangladesh, o global policy framework, o Energy Efficiency and Conservation Master Plan up to 2030 (EECMP 2030). • **Energy and climate:** Paris agreement, Conference of the Parties (COP), United Nations Framework Convention on Climate Change (UNFCCC). • **Policy Instruments:** Feed-in Tariff (FiT), Net Metering, Auctions, power purchase agreement (PPA), climate policy. **<u>Class 02</u>** • **Economics of Renewable Energy:** Capital cost, Levelized Cost of	1. **Abu Shahadat Md Ibrahim** Assistant Professor University of Dhaka 2. **Dr. Nasif shams** Associate Professor Institute of Energy Institutes, University of Dhaka

	Energy (LCOE), Internal rate of return (IRR), payback analysis, Blue economy of Bangladesh. • **Carbon Markets & Incentives:** Clean development mechanism (CDM), carbon credits, green bonds, tax incentives, net zero scenario. • **Regional Challenges & Case Study:** Local barriers to renewable energy (RE) scale-up, comparative case studies, and events in climate change. • **Workshop Session:** Group task: design a simple RE policy framework for rural electrification, mapping resources of solar, wind, and hydro power, small and micro-hydro systems.	
09	**Module 9: Challenges of Renewable Energy Implementation (02 hours)** • Economic and financial barriers • Technical and infrastructure challenges • Challenges of intermittency and grid integration of renewable energy • Social and environmental barriers • Regulatory and policy barriers • Institutional and administrative barriers • Ways to overcome the challenges • Case studies	1. **Dr. Rashidul Hasan** Asst. Professor Naval Architecture and Offshore Engineering, BMU 2. **Captain Md Moyezuddin**, BN (Retd)
10	**Module 10: Career Opportunities in Renewable Energy (02 hours)** • **Introduction to the Renewable Energy Job Market:** Overview of the global renewable energy sector and its growth; Key drivers of job creation in renewable energy (policy, technology, and investment); Current employment statistics and future projections. • **Skills and Qualifications for Renewable Energy Careers:** Technical skills (e.g., engineering, data analysis, energy modelling); Soft skills (e.g., communication, teamwork, problem-solving); Educational qualifications (degrees, certifications, and training programs); Industry-specific certifications (e.g., NABCEP for solar, PMP for project management). • **Career Paths in Renewable Energy:** Engineering and Technical Roles; Project Development and Management Roles; Role in Research and Innovation; Opportunity in Business and Finance sectors. • **Networking and Professional Development:** Importance of professional networks in the renewable energy sector; Key industry organisations and associations (e.g., IRENA, SEIA, GWEC); Online platforms for networking (e.g., LinkedIn, industry forums). • **Entrepreneurship in Renewable Energy:** Starting a business in the renewable energy sector; Opportunities in renewable energy consulting, installation, and maintenance; Funding and support for renewable energy startups. • **Future Trends in Renewable Energy Careers:** Impact of emerging technologies (e.g., green hydrogen, floating solar); Role of digitalisation and AI in renewable energy jobs; Skills needed for the future renewable energy workforce; case example of hybrid renewable energy.	1. **Dr. Nasif shams Associate Professor** Institute of Energy, University of Dhaka 2. **Dr. Rashidul Hasan** Asst. Professor Naval Architecture and Offshore Engineering, BMU
11	**Evaluation/Assessment (02 hours)**	**Director, IBBBS**