Course and Evaluation Plan

School	Engineering
Department	Energy
Semester	Autumn 2024
Course Code	EN565
Course Name	Wind and Hydro Energy
Instructor	**Sadhan Mahapatra**

Abstract

This course deals with wind and hydro energy sources and systems in detail. These are the two most important renewable energy sources in India. The installed capacities of these two renewable energy base conversion systems are highest and it also proved that the energy generation cost from these resources is economically competitive. This course deals with wind and hydro energy sources, conversion to useful energy, and systems in detail. This is a broad course aimed to teach the students on various aspects of wind and hydro energy resource assessment, conversion process, applications, and economics of energy generation.

Course Outcomes

CO1: Explain wind and hydro energy resource assessment techniques
CO2: Use of wind and hydro energy conversion principles for power generation
CO3: Analyse the performance and cost of wind and hydro energy conversion devices
CO4: Assess the environmental issues related to wind and hydro energy systems

Prerequisites of the course

Students must have a minimum understanding of fluid mechanics.

Lecture Plan

Lectures	Topic (s)
1-3	Introduction to wind energy, energy available from wind, factors influence the wind, wind energy potential in India and worldwide
4-5	Wind speed monitoring, resource assessment, time and frequency distribution
6-7	Weibull distribution, Capacity factor, Design Optimization based on Site
8-9	Problem Solving
10-11	Betz limit, power, torque and speed characteristics, wind energy conversion systems classifications
12-13	Axial Momentum Theory, Maximum Power coefficient
14-16	Aerodynamic design principles, Aerofoil, lift and drag characteristics, blade element theory and combined theory,
17	Blade linearization techniques, theoretical simulations of wind turbine
16	Wind pumps, performance analysis of wind pumps, design concept and testing
17	Principle of WEG: stand alone, grid connected, Interconnection issues
18	Hybrid applications of WECS, Economics of wind energy generation, case studies
19-22	Introduction to hydropower systems, classification, working principles,

	Assessment of hydropower potential, Hydrology
23-25	Different types of turbines, elements of turbine, selection and design criteria, characteristic curves, Power from hydro sources
26	Economic operation of Hydro power systems
27-31	Problem solving
32-34	Site selection criteria, essential elements of hydro power plant, cost of energy generation , case studies
35-36	Environmental issues with large hydro projects

Evaluation Plan

Evaluation Plan			
Test	Marks	Time	Tentative schedule
Sessional Test I	25	1 hour	8th September
Mid Term	40	2 hour	13th October
Sessional Test II (Assignment)	25	15 days	10th November
End Semester	60	3 hours	15th December
Total	**150**	**Semester**	

Assessment Criteria		**Marks distribution**			
Course Outcomes	Weightage of marks (%)	Sessional Test I (25)	Mid Term (40)	Sessional Test II (25)	End Semester (60)
CO1	25	15	15		7.5
C02	30	10	15		20
CO3	35		10	15	27.5
CO4	10			10	5
TOTAL	100	25	40	25	60

Assessment Criteria			**Marks distribution**			
Bloom Taxonomy	Level	Weightage of marks (%)	Sessional Test I (25)	Mid Term (40)	Sessional Test II (25)	End Semester (60)
Knowledge	Easy	10	5	5		5
Understanding	Easy	10	5	5		5
Application	Average	30	10	15	10	10
Analysis	Above average	30	5	10	15	15
Synthesis	Difficult	12		5		13
Evaluation	Difficult	8				12
TOTAL		**100**	**25**	**40**	**25**	**60**

Pedagogy

Teaching-learning methods to be used

- Lecture
- Presentation
- Problem solving

Text Books

[1] Johnson G. L. (2006); *Wind Energy Systems* (Electronic Edition), Prentice Hall

[2] Wagner H. and Mathur J. (2011); *Introduction to Hydro Energy Systems: Basics, Technology and Operation*, Springer

Suggested Readings

[1] Ahmed S. (2011) Wind Energy: Theory and Practice, PHI Learning
[2] Manwell JF. (2003) Wind Energy Explained: Theory, Design and Application, Wiley
[3] Mathew S. (2006); *Wind Energy: Fundamentals, Resource Analysis and Economics*, Springer
[4] Burton T. Sharpe D. Jenkins N. and Bossanyi E. (2001); *Wind Energy Handbook*, John Wiley
[5] Nag P. K. (2014); *Power Plant Engineering*, Third Edition, Tata McGraw Hill
[6] Jiandong T. (et al.) (1997); *Mini Hydropower*, John Wiley
[7] Dandekar MM and Sharma KN. (2013) Water Power Engineering, 2nd Edition, Vikas Publishing House Pvt Ltd.
[8] Rai HC. (2017) Power Plant Engineering, IK Publishing House Pvt Ltd

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