



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering

Level: Diploma

Branch: Renewable Energy

Course / Subject Code: DI03064021

Course / Subject Name: Renewable Power Plants

w. e. f. Academic Year:	2024-25
Semester:	3 rd
Category of the Course:	PCC

Prerequisite:	Law of Energy Conservation, Types of Energy sources
Rationale:	<p>The syllabus for the Renewable Power Plants course is meticulously crafted to provide a balanced and comprehensive introduction to renewable energy systems, focusing on their technical, economic, and environmental dimensions. As the demand for sustainable energy solutions continues to rise globally, the renewable energy sector is expanding rapidly. This course aims to equip diploma-level students with foundational knowledge and practical skills needed to understand, operate, and maintain renewable power plants. The course is aimed to provide exposure to methods of electricity generation. Generation of Electric Power is most important activity in power system. With growing demand for electric power, it has become more necessary to generate electric power more efficiently. It is possible with advanced technology. The course covers the primary renewable energy sources-hydro, wind, solar, biomass-each offering unique opportunities and challenges in the renewable energy landscape.</p>

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Operate and maintain Hydro Power Plant	U
02	Operate and maintain Wind Power Plant	U
03	Operate and maintain Solar Power Plant	U
04	Operate and maintain Biomass Power Plant	U

*Revised Bloom's Taxonomy (RBT)



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Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
L	T	PR		C	Theory		Tutorial / Practical	
			ESE (E)		PA(M)	PA(I)	ESE (V)	
3	0	0	3	70	30	00	00	100

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	Hydro Power Plant Contents: (1) Energy conversion process for hydro Power Station (HPS) (2) Advantages and disadvantages of Hydro Power Station (3) Selection of site of Hydro Power Station (4) Classification of Hydro Power Plant: <ul style="list-style-type: none">• Based on the head of water• Based on the condition of water• Based on operation• Based on type of load supplied (5) Elements of HPS (6) Types of Turbines used in HPS (7) Various schemes of Hydro Power Station (8) Plant layout of HPS (9) Major Hydro power stations of Gujarat	10	22 %
2.	Wind Power Plant Contents: (1) Energy conversion process in Wind Power Plant (2) Advantages and Limitations of Wind Power Plant (3) Selection of Site for Wind Power Plant (4) Devices for measuring direction and velocity of wind: Wind	12	27 %



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	<p>Vane & Anemometer</p> <p>(5) Aerodynamic drag and lift principle for rotation of wind turbine rotor</p> <p>(6) Mathematical equation of Wind Power:</p> <ul style="list-style-type: none">• Wind Duration Curve• Height vs Wind Velocity Curve• Relation among wind velocity, air mass and wind power <p>(7) Important terms regarding wind power generation:</p> <ul style="list-style-type: none">• Efficiency of wind turbine• Swept area• Cut in wind speed• Rated Wind speed• Cut out wind speed• Maximum designed speed <p>(8) Horizontal axis Wind Turbine (HAWT), Vertical axis Wind Turbine (VAWT), Comparison of Horizontal axis and Vertical axis Wind Turbine</p> <p>(9) Power output v/s wind speed characteristic of wind turbine</p> <p>(10) Block Diagram of Wind Power Plant</p> <p>(11) Advantages & Connection of Wind Farm & Types of Wind Farm:</p> <ul style="list-style-type: none">• On-Shore Wind Farm• Shore line Wind Farm• Off-Shore Wind Farm <p>(12) Major Wind Farms of Gujarat State</p>		
3.	<p>Solar Power Plant</p> <p>Contents:</p> <p>(1) Advantages and Disadvantages of Solar Energy</p> <p>(2) Solar Radiation:</p> <ul style="list-style-type: none">• Solar radiation spectrum• Extraterrestrial radiation and global radiation• Diffuse, Direct and Global radiation• Solar Constant	14	31 %



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	(3) Principles of Measurement of Solar radiation (4) Solar thermal power generation: <ul style="list-style-type: none">• Low temperature solar thermal power plant• Medium temperature solar thermal power plant• High temperature solar thermal power plant (5) Photo Voltaic cell (6) Solar Module, Solar Panel and Solar array (7) Types of PV solar cell (8) Solar photo voltaic power generation system (9) Types of solar PV Power generating system: <ul style="list-style-type: none">• Stand-alone solar PV system• Grid Interactive solar PV system• Hybrid Solar PV system (10) Advantages & Disadvantages of solar PV system.		
4.	Biomass power plant Contents: (1) Biomass (2) Forms of Biomass (3) Advantages & Limitations of Biomass (4) Conversion of Biomass into energy: <ul style="list-style-type: none">• Thermo-chemical process• Bio chemical process (5) Biomass electrical energy conversion system: <ul style="list-style-type: none">• Co - firing system• Dedicated Biomass conversion system (6) Biomass steam power plant (7) Biomass gas turbine plant (8) Biomass – IC engine plant	09	20 %
	Total	45	100



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Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	U Level	A Level	N Level	E Level	C Level
40 %	40 %	20 %	-	-	-

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1.	"Principles of Power system", Mehta, V.K., S. Chand & Co., New Delhi, 2020, ISBN: 978-8121924962
2.	"Wind Power Technology" by Earnest, Joshua, PHI Learning, New Delhi, 2013
3.	"Electrical Power Systems", Uppal, S.L., Khanna publication, New Delhi, 2011, ISBN:978-8174092380
4.	"Power plant Engineering ", Nag, P K., Tata McGraw Hill, New Delhi, 2011, ISBN:978-0-07-064815-9
5.	"Renewable Energy Technologies ", Solanki, Chetan S., PHI Learning, New Delhi, 2011
6.	"Generation and Utilization of Electrical Energy ", S. Sivanagaraju, Pearson, New Delhi, 2011, ISBN:978-81-317-33325
7.	"Solar PV Lab Manual ", Solanki, Chetan S., PHI Learning, New Delhi, 2013
8.	"A course in Power Systems", J.B.Gupta., S K Kataria & sons,2013, ISBN:978-9350143735
9.	"Biomass: as renewable source of energy ", Bibhu Prasad Ganthia, Anita Pritam, Asutosh Parida, Selva Suman Ray, Kindle Edition 2021, ASIN B09GNFS9S3
10.	"Biomass for bio energy and biomaterials", Nidhi adlakha, Rakesh bhatnagar, Syed shams yajdani, CRC PRESS,2021, ISBN 978-0367745554
11.	"Non-Conventional Energy Sources ", G. D. Rai, Publication: Khanna Publishers, ISBN: 978-8174090737
12.	"Renewable Energy Systems", David M. Buchla, Thomas E. Kissell, Thomas L. Floyd, Publication: Pearson Education, ISBN: 978-9332586826



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(b) Open-source software and website:

1. www.alternative-energy-tutorials.com
2. <http://www.mnre.gov.in/>
3. <https://www.energy.gov/eere/wind/how-do-wind-turbines-work>
4. http://www.ntpc.co.in/index.php?option=com_content&view=article&id=64&Itemid=34&lang=en
5. http://www.powergridindia.com/_layouts/PowerGrid/User/ContentPage.aspx?PID=255&LangID=English
6. <http://www.youtube.com/user/EnergyShouldBe>
7. <https://www.classcentral.com/course/swayam-bioenergy-7896>
8. <https://www.nrel.gov/research/re-biomass.html>
9. <https://www.energy.gov/eere/bioenergy/educational-resources-bioenergy-classroom>
10. <https://www.eesi.org/topics/bioenergy-biofuels-biomass/description>
11. <https://www.iea.org/energy-system/renewables/bioenergy>
12. <https://mnre.gov.in/bio-energy-overview/>
13. <https://www.irena.org/Energy-Transition/Technology/Bioenergy-and-biofuels>
14. <https://www.energy.gov/eere/bioenergy/biofuel-basics>
15. <https://nitsri.ac.in/Department/Chemical%20Engineering/BRTL12.pdf>
16. <https://www.hrpub.org/>
17. <https://www.nibe.res.in/>
18. <https://biourja.mnre.gov.in/>
19. <https://etap.com/product/wind-turbine-generator-software>
20. <https://www.ul.com/software/openwind-wind-farm-modeling-and-layout-designsoftware>
21. <https://windsim.com/software/>
22. <https://www.nrel.gov/research/re-wind.html>
23. <https://www.energy.gov/eere/wind/wind-energy-basics>
24. <https://niwe.res.in/>
25. <https://www.india.gov.in/website-national-institute-wind-energy>
26. <https://testbook.com/>

Suggested Project List:

1. Build working model to demonstrate working or Hydro Power Plant.



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2. Prepare chart of various schemes of Hydro Power Plant
3. Prepare chart of various Turbines used in Hydro Power Plant
4. Prepare chart of various Hydro Power Plant in Gujarat
5. Prepare chart of various Elements of Hydro Power Plant
6. Prepare chart of Horizontal Axis Wind Turbine
7. Prepare chart of Vertical Axis Wind Turbine
8. Prepare chart of block diagram of a Wind Power Plant
9. Prepare a chart on Comparison of Horizontal axis and Vertical axis Wind Turbine
10. Prepare a chart on Types of Wind Farm
11. Prepare a chart on Low temperature solar thermal power plant
12. Prepare a chart on medium temperature solar thermal power plant
13. Prepare a chart on High temperature solar thermal power plant
14. Prepare a chart on Solar Module, Solar Panel and Solar array
15. Prepare a chart on Types of solar PV Power generating system:
16. Prepare mini working model of solar panel with small load
17. Prepare mini working model of wind plant with small load
18. Prepare a chart for Biomass steam power plant
19. Prepare a chart for Biomass gas turbine plant
20. Prepare a chart for Biomass conversion processes.

Suggested Activities for Students:

Beyond classroom learning, the following co-curricular activities are recommended to enhance the achievement levels of various outcomes in this course. Students are encouraged to undertake these activities either individually or in groups and prepare comprehensive reports of approximately five pages for each activity. Additionally, students should gather and document physical evidences for their portfolios, which could be beneficial during placement interviews:

- a) **Project Model / Seminar Presentations: Demonstrate project models or deliver seminars on various topics covered in the course content.**
- b) **Collect data of generating capacity of renewable power plants in India and Gujarat**



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Assignments should be distributed unit-wise, and students should seek progressive assessment from the concerned course facilitators throughout the term. At the end of the term, the entire body of work should be submitted to the respective course facilitators for evaluation.

These activities will not only reinforce the theoretical understanding but also provide practical exposure and critical thinking opportunities essential for professional growth.
