



JAIPUR ENGINEERING COLLEGE
AND RESEARCH CENTRE

JAIPUR ENGINEERING COLLEGE AND RESEARCH CENTRE

JECRC Campus ,Shri Ram ki Nangal, Via-Vatika ,Tonk Road, Jaipur

Department of Mechanical Engineering

Name of Subject: Power Generation Sources

Subject Code: 7EE6-60.2

Year: 4th Year, 7th Semester



JAIPUR ENGINEERING COLLEGE
AND RESEARCH CENTRE

JAIPUR ENGINEERING COLLEGE AND RESEARCH CENTRE

JECRC Campus ,Shri Ram ki Nangal, Via-Vatika ,Tonk Road, Jaipur

Department of Mechanical Engineering

Vision and Mission of Institute:

Vision: To become a renowned center of outcome based learning, and work towards academic, professional, cultural and social enrichment of the lives of individuals and communities.

Mission:

M1: Focus on evaluation of learning outcomes and motivate students to inculcate research aptitude by project based learning.

M2: Identify, based on informed perception of Indian, regional and global needs, areas of focus and provide platform to gain knowledge and solutions.

M3: Offer opportunities for interaction between academia and industry.

M4: Develop human potential to its fullest extent so that intellectually capable and imaginatively gifted leaders can emerge in a range of professions.

Vision and Mission of Department:

Vision: The Mechanical Engineering Department strives to be recognized globally for outcome based technical knowledge and to produce quality human resource, who can manage the advance technologies and contribute to society.

Mission:

M1: To impart quality technical knowledge to the learners to make them globally competitive mechanical engineers.

M2: To provide the learners ethical guidelines along with excellent academic environment for a long productive career.

M3: To promote industry-institute relationship.



JAIPUR ENGINEERING COLLEGE
AND RESEARCH CENTRE

JAIPUR ENGINEERING COLLEGE AND RESEARCH CENTRE

JECRC Campus ,Shri Ram ki Nangal, Via-Vatika ,Tonk Road, Jaipur

Department of Mechanical Engineering

PROGRAM EDUCATIONAL OBJECTIVES (PEOS)

PEO1: To equip graduates with a strong foundation in engineering sciences, with an emphasis on mechanical engineering principles, enabling them to analyze, design, and solve real-world engineering challenges.

PEO2: To prepare graduates with sound scientific and engineering fundamentals to innovate and deliver effective solutions addressing practical challenges in mechanical engineering

PEO3: To inculcate in graduates a professional and ethical attitude, effective communication and teamwork skills, a multidisciplinary approach, entrepreneurial mindset, and the ability to connect engineering solutions with societal and environmental concerns.

PEO4: To provide students with an academic environment that fosters excellence, leadership, adherence to ethical standards, and encourages self-motivated lifelong learning essential for a successful professional career in mechanical

PEO5: To prepare students to excel in industry and higher education by providing quality education grounded in strong technical knowledge and high moral values

Program Specific Outcomes (PSOs)

PSO1: Graduates will be able to design, analyze, and fabricate electric and hybrid vehicles using modern engineering tools and sustainable practices.

PSO2: Graduates will be able to apply design principles and computational techniques, including programming and data structures, to analyze and solve mechanical engineering problems.



JAIPUR ENGINEERING COLLEGE
AND RESEARCH CENTRE

JAIPUR ENGINEERING COLLEGE AND RESEARCH CENTRE

JECRC Campus ,Shri Ram ki Nangal, Via-Vatika ,Tonk Road, Jaipur

Department of Mechanical Engineering

Program Outcomes (POs)

- PO1: Engineering Knowledge:** Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.
- PO2: Problem Analysis:** Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
- PO3: Design/Development of Solutions:** Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)
- PO4: Conduct Investigations of Complex Problems:** Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).
- PO5: Engineering Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)
- PO6: The Engineer and The World:** Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).
- PO7: Ethics:** Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
- PO8: Individual and Collaborative Team work:** Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
- PO9: Communication:** Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences
- PO10: Project Management and Finance:** Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
- PO11: Life-Long Learning:** Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)



JAIPUR ENGINEERING COLLEGE
AND RESEARCH CENTRE

JAIPUR ENGINEERING COLLEGE AND RESEARCH CENTRE

JECRC Campus ,Shri Ram ki Nangal, Via-Vatika ,Tonk Road, Jaipur

Department of Mechanical Engineering

SYLLABUS

7EE6-60.2: Power Generation Sources.

Credit: 3
3L+0T+0P

Max. Marks: 100(LA:30, ETE:70)

End Term Exam: 3 Hours

SN	CONTENTS	Hours
1	INTRODUCTION: World energy status, Current energy scenario in India, Environmental aspects of energy utilization, Environment - Economy - Energy and Sustainable Development, Energy planning.	4
2	Conventional Energy Generation Methods: Thermal Power plants: Basic schemes and working principle. Gas Power Plants: open cycle and closed cycle gas turbine plants, combined gas & steam plants-basic schemes. Hydro Power Plants: Classification of hydroelectric plants. Basic schemes of hydroelectric and pumped storage plants. Nuclear Power Plants: Nuclear fission and nuclear fusion. Fissile and fertile materials. Basic plant schemes with boiling water reactor, heavy water reactor and fast breeder reactor. Efficiencies of various power plants	8
3	SOLAR ENERGY: Basic concepts, Solar radiation - Measurement, Solar thermal systems - Flat plate and concentrating collectors, Solar passive space - Solar heating and cooling techniques - Solar desalination - Solar Pond - Solar cooker - Solar dryers-Solar furnaces - Solar pumping, Solar green house- Solar thermal electric power plant - Solar photo voltaic conversion - Solar cells - PV applications, Hybrid systems.	6
4	WIND ENERGY: Introduction-Availability- Wind power plants , Power from the wind, Wind energy conversion systems, site characteristics, Wind turbines types - Horizontal and vertical axis-design principles of wind turbine - Blade element theory, Magnus effect- Performance. Wind energy Applications - Hybrid systems, Wind energy storage, Safety and environmental aspects.	6
5	BIOMASS ENERGY: Biomass - usable forms- composition- fuel properties - applications, Biomass resources, Biomass conversion technologies - direct combustion - pyrolysis - gasification -anaerobic digestion, Bioethanol and Biodiesel Production - Economics - Recent developments.Energy farming, Biogas technology - Family biogas plants, Community and institutional biogas plants - design consideration - applications.	4
6	OTHER RENEWABLE ENERGY SOURCES: Tidal energy - Wave energy - Open and closed OTEC Cycles - Small hydro - Geothermal energy - Social and environmental aspects.Fuel cell technology - types, principle of operation - applications.Hydrogen energy production - Storage - transportation - utilization.	8
	TOTAL	



JAIPUR ENGINEERING COLLEGE
AND RESEARCH CENTRE

JAIPUR ENGINEERING COLLEGE AND RESEARCH CENTRE

JECRC Campus ,Shri Ram ki Nangal, Via-Vatika ,Tonk Road, Jaipur

Department of Mechanical Engineering

REFERENCE BOOKS (PGS)

TEXT BOOKS

1. Godfrey Boyle, "Renewable Energy", Power for a Sustainable Future, Oxford University Press, U.K, 1996.
2. Twidell.J.W & Weir.A, "Renewable Energy Sources", EFN Spon Ltd., UK, 1986
3. Tiwari.G.N, "Solar Energy – Fundamentals Design", Modelling and applications, Narosa Publishing House, New Delhi, 2002

REFERENCES:

1. Freris.L.L, "Wind Energy Conversion systems", Prentice Hall, UK, 1990.
2. Veziroglu.T.N, "Alternative Energy Sources", Vol 5 and 6, McGraw-Hill, 1978
3. Johnson Gary.L, "Wind Energy Systems", Prentice Hall, New York, 1985.
4. "Energy planning in Developed countries (U.N.)", Oxford University Press, 1984.
5. G.D. Rai, "Non Conventional Energy Sources", Khanna Publishers, New Delhi, 1999.
6. S.P. Sukhatme, "Solar Energy", Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997
7. "Renewable energy sources of conversion technology:N.K Bansal", Manfred Kleen Man and Michael Meliss, TMH Publication.
8. Kothari P, K C Singal and Rakesh Ranjan, "Renewable Energy Sources and Emerging Technologies", PHI Pvt. Ltd., New Delhi, 2008



JAIPUR ENGINEERING COLLEGE
AND RESEARCH CENTRE

JAIPUR ENGINEERING COLLEGE AND RESEARCH CENTRE

JECRC Campus ,Shri Ram ki Nangal, Via-Vatika ,Tonk Road, Jaipur

Department of Mechanical Engineering

COURSE OUTCOME

Subject: Power Generation Sources

Code: 7EE6-60.2

Power Generation Sources

CO1: Understand the principles, working, and classifications of conventional and non-conventional power generation sources.

CO2: Analyze the thermodynamic cycles and efficiency of conventional power plants such as thermal, hydro, and nuclear power plants.

CO3: Understand the design, operation, and performance characteristics of renewable energy sources.

CO4: Evaluate environmental impacts, sustainability, and economic feasibility of various power generation sources.

CO5: Select suitable power generation systems for given load/site conditions..

CO6: Demonstrate awareness of modern and sustainable power generation trends.

CO-PO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	2	2	1	1	2	2	1	1	2	2
CO2	3	3	3	2	2	2	1	2	2	2	2	3	3
CO3	3	3	3	3	2	2	2	2	2	2	2	3	3
CO4	3	3	3	3	2	2	2	2	2	3	2	3	3
CO5	3	3	3	3	2	2	2	3	3	2	2	3	3
CO6	3	3	3	3	2	2	2	3	3	2	2	3	3



JAIPUR ENGINEERING COLLEGE
AND RESEARCH CENTRE

JAIPUR ENGINEERING COLLEGE AND RESEARCH CENTRE

JECRC Campus ,Shri Ram ki Nangal, Via-Vatika ,Tonk Road, Jaipur

Department of Mechanical Engineering

Course Plan

Name of the Course: **Power Generation Sources**

Code of the course: **7EE6-60.2**

Name of Faculty: **Mr. Nitin Chhabra**

Course Outcome

CO1: Understand the principles, working, and classifications of conventional and non-conventional power generation sources.

CO2: Analyze the thermodynamic cycles and efficiency of conventional power plants such as thermal, hydro, and nuclear power plants.

CO3: Understand the design, operation, and performance characteristics of renewable energy sources.

CO4: Evaluate environmental impacts, sustainability, and economic feasibility of various power generation sources.

CO5: Select suitable power generation systems for given load/site conditions..

CO6: Demonstrate awareness of modern and sustainable power generation trends.

Unit	Topic	Lec.	CO	Specific Objectives	Expected Outcomes	Primary Reference (Godfrey Boyle)
I	Introduction to Energy Scenario	1	CO1	Understand the concept and engineering principles of the topic.	Students will explain and apply the concepts in engineering practice.	Godfrey Boyle, Renewable Energy: Power for a Sustainable Future
I	Classification of Energy Sources	2	CO1	Understand the concept and engineering principles of the topic.	Students will explain and apply the concepts in engineering practice.	Godfrey Boyle, Renewable Energy: Power for a Sustainable Future
I	Conventional Energy Sources	3	CO1	Understand the concept and engineering principles of the topic.	Students will explain and apply the concepts in engineering practice.	Godfrey Boyle, Renewable Energy: Power for a Sustainable Future
I	Non-Conventional Energy Sources	4	CO1	Understand the concept and engineering	Students will explain and apply the	Godfrey Boyle, Renewable Energy:



JAIPUR ENGINEERING COLLEGE
AND RESEARCH CENTRE

JAIPUR ENGINEERING COLLEGE AND RESEARCH CENTRE

JECRC Campus ,Shri Ram ki Nangal, Via-Vatika ,Tonk Road, Jaipur

Department of Mechanical Engineering

				principles of the topic.	concepts in engineering practice.	Power for a Sustainable Future
I	Steam Power Plant Layout	5	CO1	Understand the concept and engineering principles of the topic.	Students will explain and apply the concepts in engineering practice.	Godfrey Boyle, Renewable Energy: Power for a Sustainable Future
I	Boilers and Furnaces	6	CO1	Understand the concept and engineering principles of the topic.	Students will explain and apply the concepts in engineering practice.	Godfrey Boyle, Renewable Energy: Power for a Sustainable Future
I	Steam Turbines	7	CO1	Understand the concept and engineering principles of the topic.	Students will explain and apply the concepts in engineering practice.	Godfrey Boyle, Renewable Energy: Power for a Sustainable Future
I	Condensers and Cooling Towers	8	CO1	Understand the concept and engineering principles of the topic.	Students will explain and apply the concepts in engineering practice.	Godfrey Boyle, Renewable Energy: Power for a Sustainable Future
II	Rankine Cycle	9	CO2	Understand the concept and engineering principles of the topic.	Students will explain and apply the concepts in engineering practice.	Godfrey Boyle, Renewable Energy: Power for a Sustainable Future
II	Rankine Cycle Efficiency	10	CO2	Understand the concept and engineering principles of the topic.	Students will explain and apply the concepts in engineering practice.	Godfrey Boyle, Renewable Energy: Power for a Sustainable Future
II	Methods of	11	CO2	Understand	Students	Godfrey



JAIPUR ENGINEERING COLLEGE
AND RESEARCH CENTRE

JAIPUR ENGINEERING COLLEGE AND RESEARCH CENTRE

JECRC Campus ,Shri Ram ki Nangal, Via-Vatika ,Tonk Road, Jaipur

Department of Mechanical Engineering

	Efficiency Improvement			the concept and engineering principles of the topic.	will explain and apply the concepts in engineering practice.	Boyle, Renewable Energy: Power for a Sustainable Future
II	Performance Calculations	12	CO2	Understand the concept and engineering principles of the topic.	Students will explain and apply the concepts in engineering practice.	Godfrey Boyle, Renewable Energy: Power for a Sustainable Future
II	Hydro Power Plant Layout	13	CO2	Understand the concept and engineering principles of the topic.	Students will explain and apply the concepts in engineering practice.	Godfrey Boyle, Renewable Energy: Power for a Sustainable Future
II	Hydraulic Turbines	14	CO2	Understand the concept and engineering principles of the topic.	Students will explain and apply the concepts in engineering practice.	Godfrey Boyle, Renewable Energy: Power for a Sustainable Future
II	Site Selection for Hydro Plant	15	CO2	Understand the concept and engineering principles of the topic.	Students will explain and apply the concepts in engineering practice.	Godfrey Boyle, Renewable Energy: Power for a Sustainable Future
II	Hydro Plant Performance	16	CO2	Understand the concept and engineering principles of the topic.	Students will explain and apply the concepts in engineering practice.	Godfrey Boyle, Renewable Energy: Power for a Sustainable Future
II	Nuclear Plant Layout	17	CO2	Understand the concept and engineering principles of the	Students will explain and apply the concepts in engineering	Godfrey Boyle, Renewable Energy: Power for a



JAIPUR ENGINEERING COLLEGE
AND RESEARCH CENTRE

JAIPUR ENGINEERING COLLEGE AND RESEARCH CENTRE

JECRC Campus ,Shri Ram ki Nangal, Via-Vatika ,Tonk Road, Jaipur

Department of Mechanical Engineering

				topic.	practice.	Sustainable Future
II	Nuclear Reactors	18	CO2	Understand the concept and engineering principles of the topic.	Students will explain and apply the concepts in engineering practice.	Godfrey Boyle, Renewable Energy: Power for a Sustainable Future
II	Radiation Safety	19	CO2	Understand the concept and engineering principles of the topic.	Students will explain and apply the concepts in engineering practice.	Godfrey Boyle, Renewable Energy: Power for a Sustainable Future
II	Nuclear Plant Performance	20	CO2	Understand the concept and engineering principles of the topic.	Students will explain and apply the concepts in engineering practice.	Godfrey Boyle, Renewable Energy: Power for a Sustainable Future
III	Diesel Power Plant	21	CO2	Understand the concept and engineering principles of the topic.	Students will explain and apply the concepts in engineering practice.	Godfrey Boyle, Renewable Energy: Power for a Sustainable Future
III	Gas Turbine Plant	22	CO2	Understand the concept and engineering principles of the topic.	Students will explain and apply the concepts in engineering practice.	Godfrey Boyle, Renewable Energy: Power for a Sustainable Future
III	Comparison of Conventional Plants	23	CO2	Understand the concept and engineering principles of the topic.	Students will explain and apply the concepts in engineering practice.	Godfrey Boyle, Renewable Energy: Power for a Sustainable Future
III	Solar Radiation	24	CO3	Understand the concept and	Students will explain and	Godfrey Boyle, Renewable



JAIPUR ENGINEERING COLLEGE
AND RESEARCH CENTRE

JAIPUR ENGINEERING COLLEGE AND RESEARCH CENTRE

JECRC Campus ,Shri Ram ki Nangal, Via-Vatika ,Tonk Road, Jaipur

Department of Mechanical Engineering

				engineering principles of the topic.	apply the concepts in engineering practice.	Energy: Power for a Sustainable Future
III	Solar PV System	25	CO3	Understand the concept and engineering principles of the topic.	Students will explain and apply the concepts in engineering practice.	Godfrey Boyle, Renewable Energy: Power for a Sustainable Future
III	Solar Thermal System	26	CO3	Understand the concept and engineering principles of the topic.	Students will explain and apply the concepts in engineering practice.	Godfrey Boyle, Renewable Energy: Power for a Sustainable Future
III	Applications of Solar Energy	27	CO3	Understand the concept and engineering principles of the topic.	Students will explain and apply the concepts in engineering practice.	Godfrey Boyle, Renewable Energy: Power for a Sustainable Future
III	Wind Energy Basics	28	CO3	Understand the concept and engineering principles of the topic.	Students will explain and apply the concepts in engineering practice.	Godfrey Boyle, Renewable Energy: Power for a Sustainable Future
III	Wind Turbines	29	CO3	Understand the concept and engineering principles of the topic.	Students will explain and apply the concepts in engineering practice.	Godfrey Boyle, Renewable Energy: Power for a Sustainable Future
III	Wind Farm Performance	30	CO3	Understand the concept and engineering principles of the topic.	Students will explain and apply the concepts in engineering practice.	Godfrey Boyle, Renewable Energy: Power for a Sustainable Future



JAIPUR ENGINEERING COLLEGE
AND RESEARCH CENTRE

JAIPUR ENGINEERING COLLEGE AND RESEARCH CENTRE

JECRC Campus ,Shri Ram ki Nangal, Via-Vatika ,Tonk Road, Jaipur

Department of Mechanical Engineering

IV	Biomass Energy	31	CO3	Understand the concept and engineering principles of the topic.	Students will explain and apply the concepts in engineering practice.	Godfrey Boyle, Renewable Energy: Power for a Sustainable Future
IV	Biogas Energy	32	CO3	Understand the concept and engineering principles of the topic.	Students will explain and apply the concepts in engineering practice.	Godfrey Boyle, Renewable Energy: Power for a Sustainable Future
IV	Geothermal Energy	33	CO3	Understand the concept and engineering principles of the topic.	Students will explain and apply the concepts in engineering practice.	Godfrey Boyle, Renewable Energy: Power for a Sustainable Future
IV	Tidal/Wave/OTEC Energy	34	CO4	Understand the concept and engineering principles of the topic.	Students will explain and apply the concepts in engineering practice.	Godfrey Boyle, Renewable Energy: Power for a Sustainable Future
IV	Environmental Impacts	35	CO4	Understand the concept and engineering principles of the topic.	Students will explain and apply the concepts in engineering practice.	Godfrey Boyle, Renewable Energy: Power for a Sustainable Future
IV	Economic Analysis	36	CO4	Understand the concept and engineering principles of the topic.	Students will explain and apply the concepts in engineering practice.	Godfrey Boyle, Renewable Energy: Power for a Sustainable Future
IV	Sustainability	37	CO4	Understand the concept and engineering principles	Students will explain and apply the concepts in	Godfrey Boyle, Renewable Energy: Power for



JAIPUR ENGINEERING COLLEGE
AND RESEARCH CENTRE

JAIPUR ENGINEERING COLLEGE AND RESEARCH CENTRE

JECRC Campus ,Shri Ram ki Nangal, Via-Vatika ,Tonk Road, Jaipur

Department of Mechanical Engineering

				of the topic.	engineering practice.	a Sustainable Future
V	Selection of Power Plants	38	CO5	Understand the concept and engineering principles of the topic.	Students will explain and apply the concepts in engineering practice.	Godfrey Boyle, Renewable Energy: Power for a Sustainable Future
V	Hybrid Systems & Energy Storage	39	CO6	Understand the concept and engineering principles of the topic.	Students will explain and apply the concepts in engineering practice.	Godfrey Boyle, Renewable Energy: Power for a Sustainable Future
V	Smart Grid, Hydrogen & Modern Trends	40	CO6	Understand the concept and engineering principles of the topic.	Students will explain and apply the concepts in engineering practice.	Godfrey Boyle, Renewable Energy: Power for a Sustainable Future

Reference Books

1. Freris.L.L, "Wind Energy Conversion systems", Prentice Hall, UK, 1990.
2. Veziroglu.T.N, "Alternative Energy Sources", Vol 5 and 6, McGraw-Hill, 1978
3. Johnson Gary.L, "Wind Energy Systems", Prentice Hall, New York, 1985.
4. "Energy planning in Developed countries (U.N.)", Oxford University Press, 1984.
5. G.D. Rai, "Non Conventional Energy Sources", Khanna Publishers, New Delhi, 1999.
6. S.P. Sukhatme, "Solar Energy", Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997
7. "Renewable energy sources of conversion technology:N.K Bansal", Manfred Kleen Man and Michael Meliss, TMH Publication.
8. Kothari P, K C Singal and Rakesh Ranjan, "Renewable Energy Sources and Emerging Technologies", PHI Pvt. Ltd., New Delhi, 2008