Name of Institute : Indus Institute of Technology & Engineering
Name of Faculty : Mechanical Engineering

Course code : ME0520 (OE-7)
Course name : Non-Conventional Energy Sources
Pre-requisites: : Alternate energy sources, energy engineering, renewable energy sources
Credit points : 3
Offered Semester : V

Course coordinator

Full name : Prof. Dharmendra Sapariya
Department & location: Department of mechanical Engineering, DH-4 , 3rd floor , Bhanwar Building
Telephone : 8866245022 Ext: 3313
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Consultation times : 9 AM to 5 PM
LAB Faculty
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Consultation times : 9 AM to 5 PM

Course Objectives

1. Acquire knowledge about alternate energy sources.
2. Understand basic characteristics of alternative energy sources and technologies for their utilization.
3. Analyze the principle and operation of direct energy conversion.
4. Apply the alternate energy sources to real world energy problems.
5. Apply the alternate energy sources to real world energy application.

Course Outcomes (CO)

1. To understand ways of energy production by various unconventional energy sources.
2. Recognize the need and ability to engage in lifelong learning for further developments in this field.
3. Students will be able to identify new methodologies/ technologies for effective utilization of Non-Conventional Energy Sources.

Course Outline

UNIT-I [08]

Solar Energy
Extra-Terrestrial Radiation: Spectral distribution of extra-terrestrial radiation, solar constant, solar radiation at the earth's surface, beam, diffuse and global radiation, instruments for measuring solar radiation and sun shine, solar radiation data.

Solar Collectors
Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors, Transmission losses in the Cover, Testing of Solar Collectors.

UNIT-II [04]

Wind Energy
Working Principle, Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria, Wind Measurements

UNIT-III [04]

Biomass Energy
Origin of Biomass, Physical Methods of Bioconversion, Liquefaction of Biomass, Biological Methods for Biomass Conversion, Production of Ethanol, application of bio-gas, application of bio-gas in engines, advantages.

UNIT-IV [08]

Tidal & Ocean Thermal Energy
Mechanism of Tides and waves as energy suppliers, fundamental characteristics of tidal power, harnessing tidal energy, limitations. Ocean Thermal Energy Conversion-Principle of working, Rankine cycle, OTEC power stations in the world, problems associated with OTEC, mini-hydel power plants, and their economics.

Method of delivery
Lectures (Chalk & talk, PPT)
Lab (Model study and Discription, PPT)
Video lectures for some relevant topics

Study time
2 hours for Lectures per week
2 hours for Lab per week

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C0 1	2	1	-	1	1	-	-	-	-	-	-	1
C0 2	3	3	3	2	3	3	-	-	-	-	3	3
C0 3	3	3	3	3	1	3	-	-	-	-	1	1
ME0520	**2.7**	**2.33**	**3**	**2**	**1.67**	**3**	**-**	**-**	**-**	**-**	**2**	**1.67**

Blooms Taxonomy and Knowledge retention

Figure 1: Blooms Taxonomy

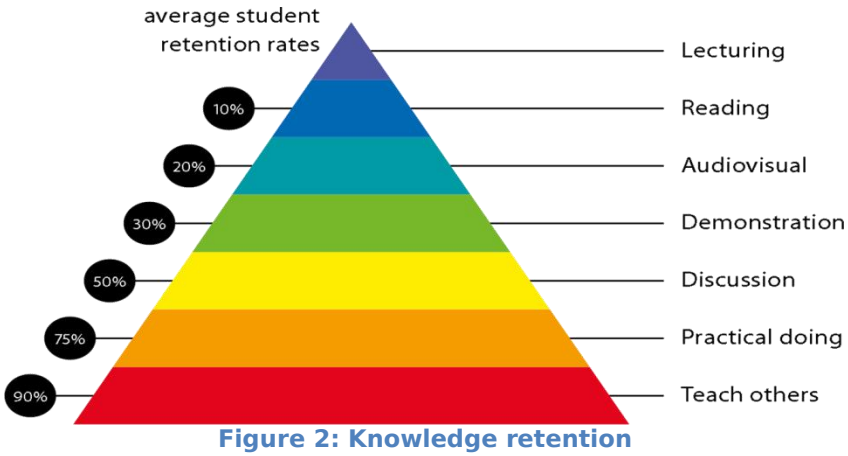

Figure 2: Knowledge retention

Graduate Qualities and Capabilities covered

(Qualities graduates harness crediting this Course)

General Graduate Qualities	Specific Department of _____Graduate Capabilities

Informed Have a sound knowledge of an area of study or profession and understand its current issues, locally and internationally. Know how to apply this knowledge. Understand how an area of study has developed and how it relates to other areas.	**1 Professional knowledge, grounding & awareness**
Independent learners Engage with new ideas and ways of thinking and critically analyze issues. Seek to extend knowledge through ongoing research, enquiry and reflection. Find and evaluate information, using a variety of sources and technologies. Acknowledge the work and ideas of others.	**2 Information literacy, gathering & processing**
Problem solvers Take on challenges and opportunities. Apply creative, logical and critical thinking skills to respond effectively. Make and implement decisions. Be flexible, thorough, innovative and aim for high standards.	**4 Problem solving skills**
Effective communicators Articulate ideas and convey them effectively using a range of media. Work collaboratively and engage with people in different settings. Recognize how culture can shape communication.	**5 Written communication** **6 Oral communication** **7 Teamwork**
Responsible Understand how decisions can affect others and make ethically informed choices. Appreciate and respect diversity. Act with integrity as part of local, national, global and professional communities.	**10 Sustainability, societal & environmental impact**

Lecture/tutorial times

(Give lecture times in the format below)

Monday: 09:55 to 10:50
Tuesday: 14:20 to 16:10 (LAB)
Friday: 11:25 to 12:20

Attendance Requirements

The University norms states that it is the responsibility of students to attend all lectures, tutorials, seminars and practical work as stipulated in the course outline. Minimum attendance requirement as per university norms is compulsory for being eligible for semester examinations.

Text Books

1. “Non-Conventional Energy Sources”, Rai G.D., Khanna Publishers, New Delhi, 1st edition,
2. “Non-Conventional Energy Sources”, N K Bansal, Vikas Publishing House, New Delhi,
3. “Renewable energy sources and conversion technology”, M. Kleemann, Tata McGraw Hill

Reference Books

1. Solar Energy: Principles of Thermal Collection& Storage, S P Sukhatme, Tata McGraw Hill, New Delhi, 2nd edition, 2010.
2. Energy Technology: Non-Conventional Renewable and Conventional, S Rao, B Parulekar, Khanna Publishers, New Delhi, 3rd edition, 1994.
3. Wind Energy Conversion Systems, Freris. L.L, Prentice Hall, UK, 1st edition, 1990 .
4. Non-Conventional Energy, Ashok V Desai, New Age International, New Delhi, 1st edition,

Web resources

1. https://lecturenotes.in/subject/57/non-conventional-energy-systems-nces
2. https://swayam.gov.in/courses/4894-july-2018-non-conventional-energy-resources.
3. https://onlinecourses.nptel.ac.in/noc18_ge09.

MOOCS

1. https://www.mooc-list.com/course/energy-principles-and-renewable-energy-edx
2. Wind Resources for Renewable Energies,https://www.mooc-list.com/course/wind-resources-renewable-
3. https://www.mooc-list.com/course/our-energy-future-coursera

ASSESSMENT GUIDELINES

Your final course mark will be calculated from the following:

(1) **Theory 100 Marks Distribution:**

(a) 60 CIE Marks

- 40 Marks MID Semester Exam
- 10 Marks Quiz
- 5 Assignment/Presentation
- 5 Attendance

(b) 40 End Semester Exam (Closed Book)

(2) **Practical 100 Marks Distribution**

(a) 60 CIE Marks

- 20 Presentation
- 20 Quiz
- 10 Assignment
- 10 Attendance

(b) 40 End Semester Practical Exam

SUPPLEMENTARY ASSESSMENT

Students who receive an overall mark less than 40% in internalcomponent or less than 40% in the end semester will be considered for supplementary assessment in the respective components (i.einternal component or end semester) of semester concerned. Students must make themselves available during the supplementary examination period to take up the respective components (internal component or end semester) and need to obtain the required minimum 40% marks to clear the concerned components.

Practical Work Report/Laboratory Report:

A report on the practical work is due the subsequent week after completion of the class by each group.

Late Work

Late assignments will not be accepted without supporting documentation. Late submission of the reports will result in a deduction of -% of the maximum mark per calendar day

Format

All assignments must be presented in a neat, legible format with all information sources correctly referenced. **Assignment material handed in throughout the session that is not neat and legible will not be marked and will be returned to the student.**

Retention of Written Work

Written assessment work will be retained by the Course coordinator/lecturer for two weeks after marking to be collected by the students.

University and Faculty Policies

Students should make themselves aware of the University and/or Faculty Policies regarding plagiarism, special consideration, supplementary examinations and other educational issues and student matters.

Plagiarism - Plagiarism is not acceptable and may result in the imposition of severe penalties. Plagiarism is the use of another person's work, or idea, as if it is his or her own - if you have any doubts at all on what constitutes plagiarism, please consult your Course coordinator or lecturer. Plagiarism will be penalized severely.

Do not copy the work of other students.
Do not share your work with other students (except where required for a group activity or assessment

Course schedule(subject to change)

(Mention quiz, assignment submission, breaksetcas well in the table under the Teaching Learning Activity Column)

	Week #	Topic & contents	CO Addressed	Teaching Learning Activity (TLA)
	Weeks 1	Introduction: what are the different non-conventional sources their application. **Solar Energy** Extra-Terrestrial Radiation: Spectral distribution of extra-terrestrial radiation,	CO-1	Lecture , chalk and talk , PPT
	Weeks 2	**Solar:** solar constant, solar radiation at the earth's surface, beam, diffuse and global radiation,	CO-1,3	Lecture & Lab
	Week 3	Solar Energy: instruments for measuring solar radiation and sun shine, solar radiation data. **Solar Collectors:** Introduction how to fetch maximum energy of solar radiation by using solar panel, concentrator, reflector and introduction about different instruments	CO-2,3	Lecture , chalk and talk , PPT
	Week 4	**Solar Collectors** Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis	CO-2	Lecture , chalk and talk , PPT
	Week 5	**Solar Collectors** advanced collectors, Transmission losses in the Cover, Testing of Solar Collectors.	CO-2	Lecture , chalk and talk , PPT
	Week 6	**Wind Energy** Working Principle, Sources and potentials, Horizontal wind mill	CO-1,3	Lecture , Lab chalk and talk , PPT
	Week 7	**Wind Energy** vertical axis windmills, performance characteristics, Betz criteria, Wind Measurements	CO-2, 3	Lecture & Lab
	Week 8	**Biomass Energy** Origin of Biomass, Physical Methods of Bioconversion, Liquefaction of Biomass, Biological Methods for Biomass Conversion	CO-1,2,3	Lecture , chalk and talk , PPT
	Week 9	**Biomass Energy** Production of Ethanol, application of bio-gas, application of bio-gas in engines, advantages.	CO-2,3	Lecture , chalk and talk , PPT

	Week 10	MID SEMESTER EXAM		
	Week 11	**Tidal & Ocean Thermal Energy** Mechanism of Tides and waves as energy suppliers, fundamental characteristics of tidal power	CO-1,2	Lecture , chalk and talk , PPT
	Week 12	**Tidal & Ocean Thermal Energy** harnessing tidal energy, limitations. Ocean Thermal Energy Conversion-Principle of working,	CO-2,3	Lecture , chalk and talk , PPT
	Week 13	**Tidal & Ocean Thermal Energy** Understanding of Rankine cycle, OTEC power stations in the world	CO-1,2	chalk and talk , PPT
	Week 14	**Tidal & Ocean Thermal Energy** problems associated with OTEC	CO-1	chalk and talk , PPT
	Week 15	**Tidal & Ocean Thermal Energy** Understanding of mini-hydel power plants, and their economics. Submission work	CO-1,2	chalk and talk , PPT