NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

Department of Electrical and Electronics Engineering

COURSE PLAN – PART I			
Name of the programme and specialization	**B.Tech. - Electrical and Electronics Engineering**		
Course Title	**Wind and Solar Electrical Systems**		
Course Code	**EEPE32**	**No. of Credits**	**3**
Course Code of Pre-requisite subject(s)	**EEPC18, EEPC21**		
Session	**January 2019**	**Section (if, applicable)**	**---**
Name of Faculty	**N. Kumaresan**	**Department**	**EEE**
Official Email	**nkumar@nitt.edu**	**Telephone No.**	**0431-2503257**
Name of Course Coordinator(s) (if, applicable)	**---**		
Official E-mail	**---**	**Telephone No.**	**---**
Course Type (please tick appropriately)	☐ **Core course**	☑ **Elective course**	

Syllabus (approved in BoS)

Department of Electrical and Electronics Engineering, National Institute of Technology, Tiruchirappalli – 620015

EEPE32 – WIND AND SOLAR ELECTRICAL SYSTEMS

Course Type: Programme Elective (PE) ***Pre-requisites:*** EEPC18, EEPC21

No. of Credits: 3

Course Objectives:

To familiarize the students with basics of solar and wind energy systems and various techniques for the conversion of solar and wind energy into electrical energy.

Course Content :

Basic characteristics of sunlight – solar spectrum – insolation specifics– irradiance and irradiation-pyranometer – solar energy statics- Solar PV cell – I-V characteristics –P-V characteristics– fill factor-Modeling of solar cell– maximum power point tracking.

PV module – blocking diode and bypass diodes– composite characteristics of PV module – PV array– PV system –PV-powered fan–PV fan with battery backup–PV-powered pumping system –PV powered lighting systems–grid- connected PV systems.

Wind source–wind statistics-energy in the wind –turbine power characteristics - aerodynamics – rotor types – parts of wind turbines– braking systems–tower- control and monitoring system.

General characteristics of induction generators– grid-connected and self-excited systems–steady-state equivalent circuit-performance predetermination–permanent magnet alternators–steady-state performance.

Power electronic converters for interfacing wind electric generators – power quality issues-hybrid systems-wind-diesel systems – wind-solar systems.

Text Books:

1. *S N Bhadra, S Banerjee and D Kastha, 'Wind Electrical Systems', Oxford University Press, 1st Edition, 2005.*
2. *Chetan Singh Solanki, 'Solar Photovoltaics: Fundamentals, Technologies and Applications' PHI Learning Publications, 2nd Edition, 2011.*

Reference Books:

1. *Roger A. Messenger and Jerry Ventre, 'Photovoltaic Systems Engineering', Taylor and Francis Group Publications, 2nd Edition, 2003.*
2. *M. Godoy Simoes and Felix A. Farret, 'Alternative Energy Systems: Design and Analysis with Induction Generators', CRC Press, 2nd Edition, 2008.*
3. *Ion Boldea, 'The Electric Generators Handbook- Variable Speed Generators', CRC Press, 2010.*
4. *Bin Wu, Yongqiang Lang, Navid Zargari, Samir Kouro, 'Power Conversion and Control of Wind Energy Systems', IEEE Press Series on Power Engineering, John Wiley & Sons, 2011.*
5. *S. Sumathi,L. Ashok Kumar,P. Surekha ,'Solar PV and Wind Energy Conversion Systems', Springer 2015.*

COURSE OUTCOMES:

Upon completion of this course students will be able to

1. Describe the solar radiation, measurements and characteristics of solar PV cell.
2. Develop the model of a PV system and its applications.
3. Describe the basic types and mechanical characteristics and model of wind turbine.
4. Analyze the electrical characteristics and operation of various wind-driven electrical generators.
5. Understand various power electronic converters used for hybrid system.

COURSE OBJECTIVES

To familiarize the students with basics of solar and wind energy systems and various techniques for the conversion of solar and wind energy into electrical energy.

MAPPING OF COs with POs

Course Outcomes Upon completion of this course students will be able to	**Programme Outcomes (PO)** (Enter Numbers only)
1. Describe the solar radiation, measurements and characteristics of solar PV cell.	**1, 2, 7, 8, 9, 14**
2. Develop the model of a PV system and its applications.	**1, 2, 4, 7, 8, 9, 14**
3. Describe the basic types and mechanical characteristics and model of wind turbine.	**1, 2, 7, 8, 9, 14**
4. Analyze the electrical characteristics and operation of various wind-driven electrical generators.	**1, 2, 7, 8, 9, 14**
5. Understand various power electronic converters used for hybrid system.	**1, 2, 4, 7, 8, 9, 12, 14**

COURSE PLAN – PART II

COURSE OVERVIEW

In the present power scenario, the demand for electrical power is fast increasing and conventional resources are depleting. So, the exploitation of Renewable energy sources for the generation of Electrical Power is being emphasized, either to augment the grid power or for supplying certain isolated loads. It includes solar, wind, geothermal, hydropower and tidal energy, plus biofuels that are grown and harvested without fossil fuels. Among the various Renewable Energy Sources, wind and solar systems have been found to be viable in contributing significant amount of electric power, when installed in locations where adequate wind/solar potential is available.

It is known that the wind velocity and solar irradiance vary widely. This varying/ fluctuating nature of power output from renewable energy sourecs would affect the operation of interconnected grids and quality of power output. In this context, combining different sources of renewable energy in the system (Hybrid system) would enhance the reliability and ensure continuity of supply of the designed rated power from these sources. In addition, use of energy storage devices such as battery is suggested to further improve the reliability and quality of power supplied to the grid / isolated loads. Power electronic controllers are extensively employed with such renewable systems for effectively managing various sources and loads.

So, this course aims to give the exposure to the students on the basics, analysis and operational aspects of wind and solar electric energy conversion systems. To have the hands-on experience with such systems, simulation / laboratory exercise, field visits and case studies are planned as part of this course.

COURSE TEACHING AND LEARNING ACTIVITIES

(Add more rows)

S.No.	Week/Contact Hours	Topic	Mode of Delivery
1	7th – 25th Jan 2019 8 contact hours	Basic characteristics of sunlight – solar spectrum – insolation specifics– irradiance and irradiation-pyranometer – solar energy statics- Solar PV cell – I-V characteristics –P-V characteristics– fill factor-Modeling of solar cell– maximum power point tracking.	Lecture / Tutorial C & T using Document viewer PPT wherever needed Simulation / Experiments wherever needed
2	28th Jan 2019 to 15th Feb 2019 8 contact hours	PV module – blocking diode and bypass diodes– composite characteristics of PV module – PV array–PV system –PV-powered fan–PV fan with battery backup–PV-powered pumping system –PV powered lighting systems–grid- connected PV systems.	
3	18th Feb 2019 to 8th Mar 2019 8 contact hours	Wind source–wind statistics-energy in the wind –turbine power characteristics - aerodynamics – rotor types – parts of wind turbines– braking systems–tower- control and monitoring system.	
4	11th – 29th Mar 2019 8 contact hours	General characteristics of induction generators– grid-connected and self-excited systems–steady-state equivalent circuit-performance predetermination–permanent magnet alternators–steady-state performance	
5	1st - 22nd April 2019 8 contact hours	Power electronic converters for interfacing wind electric generators – power quality issues-hybrid systems-wind-diesel systems – wind-solar systems.	

COURSE ASSESSMENT METHODS (shall range from 4 to 6**)**

S.No.	Mode of Assessment	Week/Date	Duration	% Weightage
1	Assessment-1 : (First 2 Units) **(Written test)**	Last week of February 2019	60 minutes	20 %
2	Assessment-2 : (3rd & 4th Units) (Written test)	2nd / 3rd week of April 2019	60 minutes	20 %
3	Assessment-3 : Simulation / Practical : 10 % Field visit/Report preparation:10 %	Details will be informed during the class work		20 %
CPA	Compensation Assessment* (First 4 Units) - **(Written test)**	4th week of April 2019	60 minutes	20 %
4	Assessment-4 Final Assessment * (All units - Written test)	1st / 2nd week of May 2019	120 minutes	40 %

Note:

1. Exact date and time for the assessments (1,2, 4 and CPA) will be informed later.
2. Attending all the assessments (i.e., Assessment 1 to 4) are MANDATORY for every student.
3. Grading will be based on the clusters (range) of the total marks (all the assessments i.e., Assessment 1 to 4, put together for each student) scored. For grading, Gap theory or Normalized curve method will be used to decide the clusters (range) of the total marks.
4. The passing minimum shall be class mean by two or maximum by three, whichever is lower. Hence, every student is expected to score the minimum mark to pass the course. Otherwise the student would be declared fail and 'F' grade will be awarded.

COURSE EXIT SURVEY (mention the ways in which the feedback about the course shall be assessed)

Feedback from the students during class committee meetings
Anonymous feedback through questionnaire
Course feedback obtained through MIS system

COURSE POLICY (including compensation assessment to be specified**)**

MODE OF CORRESPONDENCE (email/ phone etc)

1. All the students are advised to check their NITT WEBMAIL regularly. All the correspondence (schedule of classes/ schedule of assessment/ course material/ any other information regarding this course) will be done through their webmail.
2. Queries (if required) may be emailed to me / contact me during 03.00 pm to 04.00 pm on Monday with prior intimation for any clarifications.

COMPENSATION ASSESSMENT

If any student is not able to attend Assessment-1 / Assessment-2 due to genuine reason, he/she is permitted to attend the Compensation Assessment (CPA) with 20% weightage (20 marks). At any case, CPA will not be considered as an improvement test.

ATTENDANCE POLICY (A uniform attendance policy as specified below shall be followed)

- At least 75% attendance in each course is mandatory.
- A maximum of 10% shall be allowed under On Duty (OD) category.
- Students with less than 65% of attendance shall be prevented from writing the final assessment and shall be awarded 'V' grade.

ACADEMIC DISHONESTY & PLAGIARISM

- Possessing a mobile phone, carrying bits of paper, talking to other students, copying from others during an assessment will be treated as punishable dishonesty.
- Zero mark to be awarded for the offenders. For copying from another student, both students get the same penalty of zero mark.
- The departmental disciplinary committee including the course faculty member, PAC chairperson and the HoD, as members shall verify the facts of the malpractice and award the punishment if the student is found guilty. The report shall be submitted to the Academic office.
- The above policy against academic dishonesty shall be applicable for all the programmes.

ADDITIONAL INFORMATION, IF ANY

FOR APPROVAL

Course Faculty _____ CC- Chairperson _____ HOD _____

Guidelines

a) The number of assessments for any theory course shall range from 4 to 6.

b) Every theory course shall have a final assessment on the entire syllabus with at least 30% weightage.

c) One compensation assessment for absentees in assessments (other than final assessment) is mandatory. Only genuine cases of absence shall be considered.

d) The passing minimum shall be as per the regulations.

B.Tech. Admitted in				P.G.
2018	2017	2016	2015	
35% or (Class average/2) whichever is greater.		(Peak/3) or (Class Average/2) whichever is lower		40%

e) Attendance policy and the policy on academic dishonesty & plagiarism by students are uniform for all the courses.

f) Absolute grading policy shall be incorporated if the number of students per course is less than 10.

g) Necessary care shall be taken to ensure that the course plan is reasonable and is objective.