NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE PLAN – PART I			
Name of the programme and specialization	**M.Tech. Power Electronics & M.Tech. Power Systems**		
Course Title	**RENEWABLE POWER GENERATION TECHNOLOGIES**		
Course Code	**EE673**	**No. of Credits**	**3**
Course Code of Pre-requisite subject(s)	**--**	**--**	**--**
Session	**July 2019**	**Applicable to**	**Power Electronics & Power Systems streams**
Name of Faculty	**Dr N Kumaresan**	**Department**	**EEE**
Official Email	**nkumar@nitt.edu**	**Telephone No.**	**0431-2503257**
Name of Course Coordinator(s)	**---**		
Course Type	☑ **Elective course**		

Syllabus (approved in BoS)

Sun and Earth-Basic Characteristics of solar radiation-angle of sunrays on solar collector- Photovoltaic cell-characteristics-equivalent circuit-Photovoltaic modules and arrays

PV Systems - Design of PV systems-Standalone system with DC and AC loads with and without battery storage-Grid connected PV systems-Maximum Power Point Tracking

Wind energy – energy in the wind – aerodynamics - rotor types – forces developed by blades - Aerodynamic models – braking systems – tower - control and monitoring system - design considerations power curve - power speed characteristics-choice of electrical generators

Wind turbine generator systems - fixed speed induction generator-performance analysis- semi variable speed induction generator-variable speed induction generators with full and partial rated power converter topologies -isolated systems-self excited induction generator- permanent magnet alternator - performance analysis

Hybrid energy systems - wind-diesel system-wind - PV system-micro hydro-PV system – biomass - PV-diesel system-geothermal-tidal and OTEC systems

Reference Books:

1. Chetan Singh Solanki, 'Solar Photovoltaics -Fundamentals, Technologies and Applications', PHI Learning
Pvt. Ltd., New Delhi, 2011
2. Van Overstraeton and Mertens R.P., 'Physics, Technology and use of Photovoltaics', Adam Hilger, Bristol,1996.
3. John F.Walker& Jenkins. N , 'Wind energy Technology', John Wiley and sons, Chichester, UK, 1997.
4. Freries LL ,'Wind Energy Conversion Systems', Prentice Hall, U.K., 1990

COURSE OBJECTIVES

This course makes the student
- to be aware of various forms of renewable energy
- to understand in detail the wind energy conversion system and photovoltaic conversion system

MAPPING OF COs with POs

Course Outcomes	Programme Outcomes (PO) (Enter Numbers only)
1. Appraise the need and possibility of extracting solar energy and converting into electrical energy using PV cell.	**1,2,10,14**
2. Design and analyze stand-alone and grid connected PV system.	**1,2,4,7,10,14**
3. Describe the dynamics of wind turbine and electrical generator.	**1,2,10,14**
4. Select and design suitable configuration of the wind energy conversion system based on application.	**1,2,4,6,7,10,14**
5. Suggest, design and analyze hybrid energy systems.	**1,2,8,9,10,14**

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 analysis and operational aspects of wind and solar electric energy conversion systems. To have the hands-on experience with such systems, Laboratory exercise, field visits and case studies (group / team task) are planned as part of this course.

COURSE TEACHING AND LEARNING ACTIVITIES

S.No.	Week/Contact Hours	Topic	Mode of Delivery
1	2nd week of Aug. 19 (5 to 9) **(3 Contact Hours)**	Introduction – Course overview Sun and earth – Solar spectrum	Lecture / Tutorial Chalk & Talk / PPT
2	3rd week of Aug. 19 (12 to16) **(2 Contact Hours)**	Basic characteristics of solar radiation - angle of sunrays on solar collector	
3	4th week of Aug. 19 (19 to 23) **(3 Contact Hours)**	Photovoltaic cell-characteristics - Effect of temperature – Blocking and bypass diode – composite characteristics-equivalent circuit for PV cell	
4	5th week of Aug. 19 (26 to 30) **(3 Contact Hours)**	Equivalent circuit of PV cell PV Systems-Design of PV systems-	
5	1st week of Sep. 19 (2 to 6) **(2 Contact Hours)**	Standalone system with DC and AC loads with and without battery storage - Design of grid connected PV systems	
6	2nd week of Sep. 19 (9 to 13) **(3 Contact Hours)**	Maximum Power Point Tracking - Demonstration of MPPT - 100 kW grid-connected solar PV system etc.	Lecture / Field visits / Experiments
7	3rd week of Sep. 19 (16 to 20) **(3 Contact Hours)**	Wind energy-energy in the wind-aerodynamics-rotor types-forces developed by blades-Aerodynamic models-braking systems-tower-control and monitoring system **Assessment-1**	Chalk & Talk / PPT **Written test**
8	4th week of Sep.19 (23 to 27) **(3 Contact Hours)**	Design considerations-power curve-power speed characteristics-choice of electrical generators. Demonstration of 5 kVA wind-generation	Chalk & Talk / PPT Field visit
9	2nd week of Oct. 19 (7 to 11) **(3 Contact Hours)**	Wind turbine generator systems-fixed speed induction generator-performance analysis-Semi-variable speed induction generator-	Chalk & Talk / PPT Tutorial – computer programing
10	3rd week of Oct. 19 (14 to 18) **(3 Contact Hours)**	variable speed induction generators with full and partial rated power converter topologies	Chalk & Talk / PPT
11	4th week of Oct. 19 (21 to 25) **(3 Contact Hours)**	Isolated systems-self excited induction generator-permanent magnet alternator - performance analysis	Chalk & Talk / PPT
12	5th week of Oct. 19 (28.10.19 to 1.11.2019) **(3 Contact Hours)**	**Assessment – 2**	**Written test**

S.No.	Week/Contact Hours	Topic	Mode of Delivery
13	2nd week of Nov. 19 (04 to 08) **(3 Contact Hours)**	Hybrid energy systems-wind-diesel system-wind-PV system-micro-hydro-PV system	Lecture / Seminar
14	3rd week of Nov. 19 (11 to 15) **(3 Contact Hours)**	Biomass-PV-diesel system-geothermal-tidal and OTEC systems. Group / Team task assessment **Compensation Assessment (CPA)**	Lecture / seminar **Written test**
15	18.11.2019– 04.12.2019 **(2 Hrs written test)**	**End Semester Examination** Date decided by Class committee / Dean office	**Written test**

Note :
Lecture : Chalk and Talk (C&T) / Document viewer / Power Point (PPT) or any suitable mode

COURSE ASSESSMENT METHODS

S.No.	Mode of Assessment	Week/Date	Duration	% Weightage
1	Assessment 1 : Written test (First 2 Units)	3rd week of September 2019	60 minutes	20
2	Assessment 2 : Written test (For 3 & 4 Units)	5th week of October 2019	60 minutes	20
3	Literature review / report preparation / Seminar presentation	Work will be carried out along with the course		20
CPA	Compensation Assessment (Written Test)	3rd week of Nov. 2019	1 Hour	Please refer course policy for more details
4	End Semester Examination (Written test)	18.11.2019– 04.12.2019	2 Hours	40

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

1. Attending all the assessments (i.e., Assessment 1 to 4) are MANDATORY for every student.
2. 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).
3. At any case, CPA will not be considered as an improvement test.
4. 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.

5. The passing minimum shall be as per the Office of the Dean (Academic) instructions. Hence, every student is expected to score the minimum mark to pass the course as prescribed by the Office of the Dean (Academic). Otherwise the student would be declared fail and 'F' grade will be awarded.

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

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 04.00 pm to 05.00 pm on Monday with prior intimation for any clarifications.

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.