NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE PLAN – PART I			
Name of the programme and specialization	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 2022	Applicable to	Power Systems and Ph.D. Scholars
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	Week 1 to Week 2 25th August to 2nd September 3 contact hours	Introduction – Course overview Sun and earth – Solar spectrum	Lecture / Tutorial Chalk & Talk / PPT
2	Week 3 5th September to 9th September 3 contact hours	Basic characteristics of solar radiation - angle of sunrays on solar collector - Photovoltaic cell-characteristics	
3	Week 4 12th September to 16th September 3 contact hours	Effect of temperature – Blocking and bypass diode – composite characteristics-equivalent circuit for PV cell Equivalent circuit of PV cell	
4	Week 5 19th September to 23rd September 3 contact hours	Standalone system with DC and AC loads with and without battery storage - Design of grid connected PV systems	
5	Week 6 27th September to 30th September 2 contact hours	PV Systems-Design of PV systems- Maximum Power Point Tracking – Case studies on Solar PV system	
6	Week 7 3rd October to 7th October 3 contact hours	Case studies on Solar PV system Introduction to Wind energy **Assessment-1**	
7	Week 8 10th October to 14th October 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	
8	Week 9 17th October to 21st October 3 contact hours	Design considerations-power curve-power speed characteristics-choice of electrical generators - Wind turbine generator systems-fixed speed induction generator	
9	Week 10 25th October to 28th October 2 contact hours	Performance analysis- Semi-variable speed induction generator- variable speed induction generators with full and partial rated power converter topologies – case studies	
10	Week 11 31st October to 4th November 3 contact hours	Isolated systems-self excited induction generator-permanent magnet alternator -performance analysis	
11	Week 12 7th November to 11th November 3 contact hours	Hybrid energy systems-wind-diesel system-wind-PV system-micro-hydro-PV system **Assessment – 2**	
12	Week 13 to Week 14 14th November to 25th November 6 contact hours	Biomass-PV-diesel system-geothermal-tidal and OTEC systems. Seminar Presentation **Compensation Assessment (CPA)**	

S.No.	Week/Contact Hours	Topic	Mode of Delivery
13	Week 15 to Week 17 28th November to 13th December 8 contact hours	Practical sessions / assessments	Practical
15	Week 18	Assessment 4 : **Final assessment** Date decided by Class committee / Dean office	**Written test**

S.No.	Mode of Assessment	Week/Date	Duration	% Weightage
1	Assessment 1 : Written test (First 2 Units)	Week 7	60 minutes	20
2	Assessment 2 : Written test (For 3 & 4 Units)	Week 12	60 minutes	20
3	Assessment 3: Practical sessions	This will be carried out along with the course.		20
CPA	Compensation Assessment (Written Test)	Week 13 / week 14	1 Hour	Please refer course policy for more details
4	Assessment 4 : Final assessment (Written test)	Week 18	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 will be 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 and may fix the time for discussion.

FOR APPROVAL

Ramanesan

Course Faculty

CC- Chairperson

HoD / EEE