	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2018-19**
Department	**Electrical Engineering**	Semester	**VIII**

Course Code	Course Name		Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE416	**Renewable Energy Systems**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives	**To impart in-depth knowledge on environmental impact of renewable energy sources.**	Course Outcomes	CO1 Able to acquire knowledge of different types of renewable energy sources.
	To introduce the basic concepts on solar and wind energy systems		CO2 Able to apply knowledge of solar photovoltaic systems, their operating principle and solar thermal system in practical applications.
	To deliver an in-depth understanding on different energy sources and their applications.		CO3 Able to understand and analyze wind energy conversion systems with its control scheme for effective power generation.
	To explain the concept of hybrid distributed generation system with suitable control scheme for standalone and grid-tied applications.		CO4 Able to gain an understanding of the biomass, hydrogen, nuclear resources and power generation using these sources.
			CO5 Able to learn and apply knowledge of hybrid energy systems for development of future renewable energy generation system.

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1	**3**	**3**	**2**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**2**	**0**	**3**
2	CO2	**3**	**3**	**1**	**1**	**2**	**2**	**1**	**0**	**0**	**0**	**0**	**1**	**3**	**1**	**3**
3	CO3	**3**	**3**	**1**	**2**	**2**	**2**	**1**	**0**	**0**	**0**	**0**	**1**	**3**	**1**	**3**
4	CO4	**3**	**3**	**1**	**1**	**1**	**3**	**1**	**0**	**0**	**0**	**0**	**1**	**3**	**1**	**3**
5	CO5	**3**	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**1**	**3**	**1**	**3**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction to Energy Resources** Energy sources on earth – World energy resources – Indian energy scenario – Global energy problems and role of renewable energy – renewable energy resources and their importance – Environmental aspects of energy utilization.	**04**	**CO1**
II	**Solar Energy and Applications** Availability of solar energy – nature of solar energy – solar cell energy conversion, efficiency, characteristics – effect of variation of solar insolation and temperature – losses – components of PV systems – solar PV electric power generation and applications – Photo thermal systems – F chart method, φ–F chart method – Utilizability modeling & simulation of solar energy systems – life cycle analysis of solar energy system.	**07**	**CO2**
III	**Wind Energy Conversion System** Wind resource assessment – power conversion technologies – wind power estimation techniques – principles of aerodynamics of wind turbine blade & wind mechanics – class of wind turbines – various aspects of wind turbine design – wind turbine generators: induction, synchronous machine, constant V & f and variable V & f generations – wind electric generation schemes.	**07**	**CO3**
IV	**Bio-Mass, Bio-Gas, Tide and Wave Energies** Basic concepts and principles of operation – Operating principle of biomass – Combustion and fermentation, anaerobic digester, Tidal power generation – Wave energy utilization.	**04**	**CO4**
V	**Hydrogen Energy** Hydrogen as a renewable energy source & sources of hydrogen – Fuel cells – principle of operation – classification and types of fuel cells – Application in Electric Vehicle– Limitations and future prospect.	**04**	**CO4**
VI	**Nuclear Energy** International nuclear energy policies and regulations, nuclear energy technologies – fuel enrichment, different types of nuclear reactors – nuclear waste disposal – nuclear fusion.	**04**	**CO4**
VII	**Distributed Generation Systems** Hybrid systems – case study of Diesel-PV-Wind-fuel cell hybrid system – effects of renewable energy into the grid – power quality, stability – intentional and unintentional islanding – power converter topologies for grid interconnection, modelling & control of grid interactive power converters – closed-loop control schemes – synchronization and phase locking techniques – standalone & grid-tied systems.	**06**	**CO5**
	Total Hours	**36**	

Essential Readings

1. Andrews J, Jelley N, "Energy Science", Oxford University Press, 1st edition, 2010

2. B.H. Khan , "Non-Conventional Energy Resources", Tata McGrawHill, 1st edition, 2009.

3. Remus Teodorescu, Marco Liserre, Pedro Rodriguez, "Grid Converters for Photovoltaic and Wind Power Systems", John Wiley & Sons, 1st edition , 2010.

Supplementary Readings

1. Fang Lin Luo, Hong Ye, "Renewable Energy Systems: Advanced Conversion Technologies and Applications", CRC Press, 1st edition, 2013.

2. H Lee Willis, Walter G Scott "Distributed Power Generation, Planning & Evaluation", CRC Pres, 1st edition , 2000.