Course Code/Name	U23MEV36/ RENEWABLE ENERGY TECHNOLOGIES			
Year/Section/Department	III/ /MECHANICALENGINEERING			
Credits Details	L:3	T:0	P: 0	C:3
Total Contact Hours Required	45			

Syllabus:

UNIT I/ ENERGY SCENARIO	**9**
Indian energy scenario in various sectors – domestic, industrial, commercial, agriculture, transportation and others – Present conventional energy status – Present renewable energy status- Potential of various renewable energy sources-Global energy status-Per capita energy consumption - Future energy plans	
UNIT II/ SOLAR ENERGY	**9**
Solar radiation – Measurements of solar radiation and sunshine – Solar spectrum - Solar thermal collectors – Flat plate and concentrating collectors – Solar thermal applications – Solar thermal energy storage – Fundamentals of solar photo voltaic conversion – Solar cells – Solar PV Systems – Solar PV applications.	
UNIT III/ WIND ENERGY	**9**
Wind data and energy estimation – Betz limit - Site selection for windfarms – characteristics - Wind resource assessment - Horizontal axis wind turbine – components - Vertical axis wind turbine – Wind turbine generators and its performance – Hybrid systems – Environmental issues - Applications.	
UNIT IV/ BIO - ENERGY	**9**
Bio resources – Biomass direct combustion – thermochemical conversion - biochemical conversion-mechanical conversion - Biomass gasifier - Types of biomass gasifiers - Cogeneration –-Carbonisation – Pyrolysis - Biogas plants – Digesters –Biodiesel production – Ethanol production - Applications.	
UNIT V/ OCEAN AND GEOTHERMAL ENERGY	**9**
Small hydro - Tidal energy – Wave energy – Open and closed OTEC Cycles – Limitations – Geothermal energy – Geothermal energy sources - Types of geothermal power plants – Applications - Environmental impact.	

Objective:

The main learning objective of this course is to prepare the students for:

To know the Indian and global energy scenario

To learn the various solar energy technologies and its applications.

To educate the various wind energy technologies.

To explore the various bio-energy technologies.

To study the ocean and geothermal technologies

Text Book:

T1: Fundamentals and Applications of Renewable Energy | Indian Edition, by Mehmet Kanoglu, Yunus A. Cengel, John M. Cimbala, cGraw Hill; First edition (10 December 2020), ISBN-10 : 9390385636

T2: Renewable Energy Sources and Emerging Technologies, by Kothari, Prentice Hall India Learning Private Limited; 2nd edition (1 January 2011), ISBN-10 : 8120344707

Reference Book:

R1 : Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press, U.K., 2012.

R2 : Rai.G.D., "Non-Conventional Energy Sources", Khanna Publishers, New Delhi, 2014. Sukhatme.S.P., "Solar Energy: Principles of Thermal Collection and Storage", Tata

McGraw Hill Publishing Company Ltd., New Delhi, 2009.

R3 : Tiwari G.N., "Solar Energy – Fundamentals Design, Modelling and applications", Alpha

Science Intl Ltd, 2015.

R4 : Twidell, J.W. & Weir A., "Renewable Energy Resources", EFNSpon Ltd., UK, 2015

Website:

W1: https://www.nationalgeographic.com/environment/energy/reference/renewable-energy/

W2: https://www.dmme.virginia.gov/DE/LinkDocuments/HandbookAlternativeEnergy.pdf

W3: https://www.un.org/en/climatechange/what-is-renewable-energy

W4: https://mnre.gov.in/

Online Mode of Study (if Any):

OMS1:https://nptel.ac.in/courses/121/106/121106014

OMS2: https://www.edfenergy.com/for-home/energywise/renewable-energy-sources

OMS3: https://www.twi-global.com/technical-knowledge/faqs/renewable-energy

OMS4: https://justenergy.com/blog/7-types-renewable-energy-future-of-energy/

Based on your uploaded syllabus for , I prepared **Anna University End Semester Exam pattern questions**:

- **20 × 2-mark questions with answers from each unit**
- **10 × 16-mark questions from each unit**

UNIT I – ENERGY SCENARIO

2 Marks Questions and Answers (20)

1. **What is energy?**
   Energy is the ability to do work.

2. **Define renewable energy.**
   Energy obtained from naturally replenishing resources such as solar, wind, biomass etc.

3. **What is conventional energy?**
   Energy obtained from fossil fuels like coal, petroleum and natural gas.

4. **What is non-conventional energy?**
   Energy obtained from renewable resources like solar, wind and biomass.

5. **What is per capita energy consumption?**
   Average energy used per person in a country per year.

6. **List any four renewable energy sources.**
   Solar, wind, biomass, geothermal.

7. **What is energy scenario?**
   It describes the production, consumption and availability of energy resources in a region.

8. **Mention sectors of energy consumption in India.**
   Domestic, industrial, agriculture, transport, commercial.

9. **What is global energy demand?**
   Total energy required worldwide.

10. **What is fossil fuel?**
    Fuel formed from organic matter over millions of years.

11. **Define energy conservation.**
    Efficient use of energy to reduce consumption.

12. **What is sustainable energy?**
    Energy that meets present needs without affecting future generations.

13. **State two disadvantages of fossil fuels.**
    Pollution and depletion.

14. **What is energy planning?**
    Planning the production and utilization of energy resources.

15. **What is carbon emission?**
    Release of CO_2 during energy production.

16. **What is energy crisis?**
    Shortage of energy resources.

17. **Define renewable energy potential.**
    Maximum possible energy that can be produced from renewable sources.

18. **What is industrial energy consumption?**
    Energy used in manufacturing processes.

19. **What is transport energy consumption?**
    Energy used in vehicles.

20. **What is commercial energy consumption?**
    Energy used in offices, malls and institutions.

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16 Marks Questions (10)

1. Explain the **Indian energy scenario in different sectors**.
2. Discuss the **present status of conventional energy resources**.
3. Explain the **renewable energy potential in India**.
4. Compare **conventional and renewable energy sources**.
5. Explain **global energy consumption trends**.
6. Discuss **per capita energy consumption and its importance**.
7. Explain **future energy planning strategies in India**.
8. Write detailed notes on **energy demand in domestic and industrial sectors**.
9. Discuss the **need for renewable energy development**.
10. Explain **energy security and sustainability**.

UNIT II – SOLAR ENERGY

2 Marks Questions and Answers (20)

1. **What is solar radiation?**
   Energy emitted by the sun in the form of electromagnetic waves.

2. **What is solar constant?**
   Solar radiation received outside earth's atmosphere ≈ **1367 W/m²**.

3. **What is solar spectrum?**
   Distribution of solar radiation over different wavelengths.

4. **What is sunshine duration?**
   Total hours of bright sunshine in a day.

5. **What is solar collector?**
   Device used to collect solar thermal energy.

6. **Types of solar collectors?**
   Flat plate and concentrating collectors.

7. **Define flat plate collector.**
   A stationary collector used to absorb solar radiation.

8. **What is concentrating collector?**
   Collector that focuses sunlight using mirrors.

9. **What is solar thermal energy storage?**
   Storage of heat energy for later use.

10. **What is photovoltaic effect?**
    Conversion of light energy into electrical energy.

11. **What is solar cell?**
    Semiconductor device converting sunlight into electricity.

12. **What is PV module?**
    Group of solar cells connected together.

13. **What is PV array?**
    Combination of several PV modules.

14. **What is inverter?**
    Device converting DC to AC.

15. **What is solar water heater?**
    Device used to heat water using solar energy.

16. **What is solar dryer?**
    Device used to dry agricultural products.

17. **What is solar cooker?**
    Device using solar energy to cook food.

18. **What is solar PV system?**
    System generating electricity using solar panels.

19. **What is grid connected PV system?**
    Solar system connected to utility grid.

20. **What is off-grid PV system?**
    Stand-alone solar power system.

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16 Marks Questions (10)

1. Explain **solar radiation and measurement methods**.
2. Explain **solar spectrum and solar constant**.
3. Describe the **construction and working of flat plate collector**.
4. Explain **concentrating solar collectors with diagram**.
5. Discuss **solar thermal energy storage methods**.
6. Explain **solar photovoltaic conversion principle**.
7. Describe **construction and working of solar cell**.
8. Explain **solar PV system components and working**.
9. Discuss **applications of solar energy**.
10. Compare **solar thermal and solar PV systems**.

UNIT III – WIND ENERGY

2 Marks Questions and Answers (20)

1. **What is wind energy?**
   Energy obtained from moving air.

2. **What causes wind?**
   Uneven heating of earth by the sun.

3. **What is wind turbine?**
   Machine converting wind energy into mechanical energy.

4. **Define wind power.**
   Power generated from wind motion.

5. **What is Betz limit?**
   Maximum efficiency of wind turbine = **59.3%**.

6. **What is wind farm?**
   Group of wind turbines installed together.

7. **What is wind speed?**
   Rate of air movement.

8. **What is site selection for wind farm?**
   Choosing suitable location for wind turbine installation.

9. **What is horizontal axis wind turbine (HAWT)?**
   Turbine with horizontal rotor axis.

10. **What is vertical axis wind turbine (VAWT)?**
    Turbine with vertical rotor axis.

11. **Name two types of VAWT.**
    Darrieus and Savonius.

12. **What is wind resource assessment?**
    Evaluation of wind potential at a site.

13. **What is rotor?**
    Rotating part of wind turbine.

14. **What is nacelle?**
    Housing for turbine components.

15. **What is wind turbine generator?**
    Generator producing electricity from turbine rotation.

16. **What is hybrid energy system?**
    Combination of two or more energy sources.

17. **What is cut-in speed?**
    Minimum wind speed to start turbine.

18. **What is cut-out speed?**
    Wind speed at which turbine stops for safety.

19. **What is rated wind speed?**
    Speed at which turbine produces rated power.

20. **State one environmental issue of wind energy.**
    Noise pollution.

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16 Marks Questions (10)

1. Explain **wind energy conversion principles**.
2. Derive and explain the **Betz limit**.
3. Explain **site selection criteria for wind farms**.
4. Describe **components of horizontal axis wind turbine**.
5. Explain **vertical axis wind turbine types**.
6. Explain **wind resource assessment methods**.
7. Discuss **wind turbine performance characteristics**.
8. Explain **wind turbine generators**.
9. Write notes on **hybrid wind energy systems**.
10. Discuss **environmental impacts and applications of wind energy**.

UNIT IV – BIO-ENERGY

2 Marks Questions and Answers (20)

1. **What is biomass?**
   Organic material used as fuel.

2. **Examples of biomass resources?**
   Wood, crop residues, animal waste.

3. **What is direct combustion?**
   Burning biomass directly for heat.

4. **What is gasification?**
   Conversion of biomass into combustible gas.

5. **What is pyrolysis?**
   Thermal decomposition of biomass without oxygen.

6. **What is carbonisation?**
   Conversion of biomass into charcoal.

7. **What is biogas?**
   Gas produced from anaerobic digestion.

8. **Main component of biogas?**
   Methane.

9. **What is biodiesel?**
   Fuel produced from vegetable oils.

10. **What is ethanol fuel?**
    Alcohol fuel produced from biomass.

11. **What is cogeneration?**
    Simultaneous production of heat and electricity.

12. **What is biomass gasifier?**
    Device converting biomass into gas.

13. **Types of gasifiers?**
    Updraft, downdraft, fluidized bed.

14. **What is digester?**
    Tank used in biogas production.

15. **What is anaerobic digestion?**
    Decomposition without oxygen.

16. **What is mechanical conversion?**
    Physical conversion of biomass energy.

17. **What is biochemical conversion?**
    Conversion using microorganisms.

18. **What is thermochemical conversion?**
    Conversion using heat.

19. **What is biofuel?**
    Fuel produced from biological sources.

20. **One advantage of biomass energy?**
    Renewable and carbon neutral.

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16 Marks Questions (10)

1. Explain **biomass energy resources**.
2. Discuss **biomass direct combustion system**.
3. Explain **biomass gasification process and types**.
4. Explain **thermochemical conversion of biomass**.
5. Explain **biochemical conversion methods**.
6. Describe **construction and working of biogas plant**.
7. Explain **types of biogas digesters**.
8. Discuss **biodiesel production process**.
9. Explain **ethanol production from biomass**.
10. Explain **applications of bio-energy technologies**.

UNIT V – OCEAN & GEOTHERMAL ENERGY

2 Marks Questions and Answers (20)

1. **What is tidal energy?**
   Energy from rise and fall of ocean tides.

2. **What is wave energy?**
   Energy obtained from ocean surface waves.

3. **What is OTEC?**
   Ocean Thermal Energy Conversion.

4. **What is open cycle OTEC?**
   System using seawater as working fluid.

5. **What is closed cycle OTEC?**
   System using ammonia as working fluid.

6. **What is small hydro power?**
   Hydropower with capacity less than 25 MW.

7. **What is geothermal energy?**
   Energy from earth’s internal heat.

8. **Sources of geothermal energy?**
   Hot springs, geysers, volcanic regions.

9. **Types of geothermal plants?**
   Dry steam, flash steam, binary cycle.

10. **What is flash steam plant?**
    Plant using high pressure hot water to produce steam.

11. **What is binary cycle plant?**
    Plant using secondary working fluid.

12. **What is geothermal reservoir?**
    Underground storage of hot water.

13. **What is tidal barrage?**
    Dam built across tidal basin.

14. **What is wave energy converter?**
    Device converting wave motion to electricity.

15. **Advantage of geothermal energy?**
    Continuous power supply.

16. **Disadvantage of tidal energy?**
    High installation cost.

17. **What is environmental impact of geothermal energy?**
    Release of gases.

18. **What is ocean temperature gradient?**
    Difference between surface and deep water temperature.

19. **What is hydrothermal resource?**
    Underground hot water reservoir.

20. **What is ocean energy?**
    Energy obtained from oceans.

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16 Marks Questions (10)

1. Explain **small hydro power plants**.
2. Describe **tidal energy conversion systems**.
3. Explain **wave energy conversion technologies**.
4. Explain **OTEC open cycle system**.
5. Explain **OTEC closed cycle system**.
6. Discuss **limitations of ocean energy systems**.
7. Explain **geothermal energy sources and characteristics**.
8. Describe **types of geothermal power plants**.
9. Discuss **applications of geothermal energy**.

10. Explain **environmental impacts of ocean and geothermal energy**.