

## SEMESTER II

PHY (N)-121

RENEWABLE ENERGY

Credit: 03

### BLOCK-I: Energy Scenario and solar energy

#### Unit-1: Overview of Energy scenario:

Classification of energy, Primary and Secondary Energy, Commercial Energy and Non Commercial Energy, Renewable and Non-Renewable Energy, Conventional and Non-conventional energy resources , Global Primary Energy Reserves, Primary Energy production, Global Primary Energy Consumption, Energy Distribution Between Developed and Developing Countries, Primary energy production, World electricity generation, Total energy supply (TES), Indian Energy Scenario, Energy Supply, Final Energy Consumption, Sector Wise Energy Consumption in India , Energy Needs of Growing Economy. India's Energy Needs, Per Capita Energy, Energy Pricing in India, Energy Sector Reforms, Electricity Act, 2003

#### Unit-2: Solar Radiation and Thermal:

Solar radiation, Irradiance and irradiation, Extraterrestrial radiation, Spectral distribution of Extraterrestrial radiation, Terrestrial solar radiation (Solar radiation on earth surface), Insolation, Beam radiation, Diffuse radiation , Total or global radiation, Air mass (m), Solar radiation geometry, Solar radiation measurements, Pyranometer, Pyrheliometer or Tube Solarimeter, Sunshine Recorder, Average daily global solar radiation, Solar Thermal Collectors, Flat Plate Solar Thermal Collectors, Concentrating Solar collectors, Linear Fresnel reflector (LFR)

#### Unit-3: Solar Photovoltaic Devices:

Photo voltaic Technology, Present status, Solar cell technology, Equivalent circuit of PV cell, Characteristics of PV system, Array design, Building integrated PV system and its component, Sizing and Economics, Peak power operation, Stand alone and Grid connected system, Stand-alone PV system, Grid connected system PV system, Solar constant, solar radiation spectrum, Classification of solar cell, First generation single crystalline and poly crystalline cell, Application of PV cell

### Block -II: Types of Renewable Energy Resources

#### Unit-4: Wind Energy:

Introduction to wind power, History and evolution of wind energy, Status of wind energy in India, Uses of wind energy, Benefits of wind energy, Limitations of wind energy, Energy available in the wind, Wind energy conversion system, Lift and drag, Principle of power generation from wind, Theoretical maximum wind power, Basic components of wind energy conversion system, Wind turbine, Wind Turbine Classification, Horizontal axis wind turbine (HAWT), Vertical axis wind turbine (VAWT), Parameters influencing wind energy conversion, Designing of wind turbine, Effect of wind turbine on grid, Controlling parameters for power generation of wind turbine

#### Unit-5: Geothermal Energy:

Origin of Geothermal Energy, Nature of Geothermal Fields, Geothermal Resources, Hydrothermal Reservoirs, Enhanced Geothermal Systems (EGS), Geopressured Reservoirs, Hot Dry Rock (HDR), Magma Reservoirs, Types of Geothermal Resources, Hydrothermal Resources, Geopressured Resources, Hot Dry Rock Resources (HDR), Magma Resources, Interconnection of Geothermal fossil l systems, Advantages of Geothermal energy over other energy Sources, Disadvantages of Geothermal energy over other energy Sources

### **Unit-6: Ocean Energy:**

Introduction to Ocean Energy, Historical Development and Milestones, The Role of Ocean Energy in the Renewable Energy Sector, The Importance of Ocean Energy, Types of Ocean Energy, Tidal Energy, Tidal Energy Technologies and Projects, Merits of Tidal Energy, Demerits of Tidal Energy, Wave Energy, Merits of Wave Energy, Demerits of Wave Energy, Ocean Thermal Energy, Conversion (OTEC), Working principle of OTEC, Brief History of Ocean Thermal Energy Conversion, OTEC cycle and system, Components of an OTEC System, Heat Exchangers, Turbine, Sea Water Pumps, Cold Water Conduit, Station keeping and mooring, Data acquisition and control, Startup and Shutdown, Indian efforts on OTEC, Challenges and Future Directions

### **Unit-7: Bio Energy:**

Definition of Biomass, Sources of Biomass, Advantages of Biomass, Disadvantages of Biomass, Conversion of Biomass into Fuels, Biochemical Processes, Thermochemical Processes, Hydrothermal Processes, Biodiesel Production, Alcohol Fermentation, Formation of Bio-Energy, Energy through Fermentation, Anaerobic Fermentation, Pyrolysis, Gasification Process, Types of Gasifiers, Biogas Plant, What is a Biogas plant, Working of a Biogas Plant, Uses of a Biogas Plant, Advantages and Disadvantages of Biogas Plants

## **Block-III: Energy Storage and Environmental Effects**

### **Unit-8: Energy Storage:**

Hybrid Energy System, Energy Storage System, Types Of Energy Storage Scenarios, Types Of Batteries, Primary Batteries, Secondary Batteries, Battery Management System, Functions, Monitor, Energy Recovery, Battery Connection To Load Circuit, Balancing, Topologies, Flywheel Energy Storage, Main Components, Physical Characteristics, Energy Storage Efficiency, Effects of Angular Momentum in Vehicles, Full Motion Gimbals, Limited-Motion Gimbals, Counterbalancing Of Angular Momentum, Applications, Transportation , Rail Electrification, Uninterruptible Power Supplies, Test Laboratories, Fuel Cell, Hydrogen, Use of Fuel Cells, Supercapacitor, Electrical Double-Layer Capacitance, Electrochemical Pseudocapacitance, Biomass and Biofuels, Uses in Different Contexts

### **Unit-9: Environmental Effects:**

Environmental Degradation, Biodiversity Loss, Impacts of Environmental Degradation, Water Degradation, Climate Change and Temperature, Climate Change and Precipitation, Population Growth, Water Management, Consumption Increases, Deforestation, Environmental Effect of Thermal Power Station, Environmental Effect of Nuclear Power Station, Environmental Effect of Hydroelectric Power Project , Geothermal Power, Power Station Types, Dry Steam Power Stations, Flash Steam Power Stations, Binary Cycle Power Stations, Environmental Impact, Economics, Ocean Wave Energy Harvesting, Sources of Harvesting Ocean Energy, Wind Energy Harvesting, Wind Energy Harvesting Technology, Solar Energy Harvesting, Photovoltaic Solar Panels, Thermal Energy Harvesting: Energy of Electromagnetic Radiation, Solar Water Heaters, Vacuum Tube Solar Water Heater, Molten Salt Solar Power, The Future of Harvesting Solar Energy, Bioenergy, Biomass Feedstocks, Dedicated Energy Crops, Agricultural Crop Residue, Forestry Residues, Algae, Wood Processing Residues, Sorted Municipal Waste, Wet Waste.