

Menoufia University
Faculty of Engineering, Shebin El-Kom
Mechanical Engineering Department
Second Semester Examination, 2019-2020
Date of Exam: 09/ 08/ 2020



Subject: Renewable Energy
Code: MPE 613
Year : M.Sc.
Time Allowed : 3 hours
Total Marks : 100 marks

Solve all questions

Question one (20 Marks)

Solar and wind energies are widely applied for generating electricity, which can be applied to different applications. These energy sources are time-dependent. Likewise, the applications are time dependent, but in a different manner than the solar and wind energy supply. Thence, the storage of electrical energy is necessary if these energy sources are to meet substantial portions of an energy demand. Pick out and describe in details three efficient methods for storing electrical energy when using wind or solar energy scheme.

Question tow (30 Marks)

Solar thermal power/electric generation systems collect and concentrate sunlight to produce the high temperature heat needed to generate electricity. All solar thermal power systems have solar energy collectors with two chief components: reflectors (mirrors) that capture and focus sunlight onto a receiver. In most types of systems, a heat-transfer fluid is heated and circulated in the receiver and used to produce steam. The steam is converted into mechanical energy in a turbine, which powers a generator to produce electricity. Solar thermal power systems have tracking systems that keep sunlight focused onto the receiver throughout the day as the sun changes position in the sky. Solar thermal power plants usually have a large field or array of collectors that supply heat to a turbine and generator.

Solar thermal power systems may also have a thermal energy storage system component that allows the solar collector system to heat an energy storage system during the day, and the heat from the storage system is used to produce electricity in the evening or during cloudy weather. Solar thermal power plants may also be hybrid systems that use other fuels (usually natural gas) to supplement energy from the sun during periods of low solar irradiation. Parabolic trough linear concentrating systems are generally used in the Solar Energy Generating System (SEGS).

If a piece of land with area A at a specified site is allocated for constructing a SEGS, you are requested to create a detailed plan for conception and building this system using parabolic trough collectors PTCs as solar collectors showing the accompanying details:

1. Detailed specifications of the PTC.
2. Arrangement of the PTCs on the land.
3. The maximum power to be generated by the solar collectors.
4. The type of the energy storage system if necessary, showing the role of this system.

Question three (50 Marks)

- (a) Wind turbines encounter some aerodynamic phenomena that bear on their functioning. You are requested to set a procedure for detailed design and prediction of the performance of a wind turbine for generating electricity considering all aerodynamic phenomena occurring during the turbine operation. Discuss the different forces exerted on the wind turbine. (20 Marks)
- (b) For a site in Egypt with most frequent wind speed of 8 m/s, you are requested to design a wind turbine used for supplying electrical power of 400 kW. (30 Marks)