College of Engineering, Pune
End Semester examination – Nov-Dec 2013
Branch: Electrical Engineering
Semester: VII
EE5112: Wind & Solar

Date: /   /2013   Duration:3 hrs
Time: Max. Marks 60

Instructions:
   i)   All questions compulsory
   ii)   Use proper scales for figs wherever required
   iii)   Assume proper data if necessary
   iv)   Numbers to right indicate Marks to full or sub questions
   v)   All questions be started from new page

Q.No.1   **(12)**

a) Obtain an expression for total solar radiation flux falling on tilted surface at any
instant.   (04)

b) Discuss following solar radiation measuring devices   (05)
    i.   Pyranometer
    ii.   pyrhelliometer.

a) Determine the local apparent time corresponding to 15.45 Hrs (IST) for Kolkata
($22^{\circ}39$'N and $88^{\circ}27$' E) on August 20, 2013. The equation for the time correction is
5'.   (03)

Q. No 2)   **(12)**

a) What is solar thermal collector? With neat labelled diagram discuss in brief
functioning of each component of liquid flat plate collector.   (05)

b) Discuss with the aid of block diagram the schemes employed for solar water pumping
system   (04)

OR

c) With neat sketch distinguish between various solar thermal collectors   (04)

d) Estimate the collector efficiency of a solar kiln having kiln temperature $60^{\circ}C$
surrounding temperature $36^{\circ}C$, area of the collector surface 25X300X300 mm^2 for
the radiation intensity 840 W/m^2 and 960 W/m^2 (03)

Q.No.3) **(12)**

a) Draw an equivalent circuit of a solar cell and deduce the relation for Voc (05)

b) Estimate the maximum power developed and efficiency of a solar cell having following parameters. Voc=0.4 volts, Short circuit current density=500 mA/Cm². fill factor =40%. The effective area of the cell is 4 Cm² under an illumination of 0.6 Sun. What happens if area is doubled. (02)

c) Describe MPPT, and explain reference cell based algorithm for MPPT. (05)

Q. No 4) **(12)**

a) From basic thermodynamics deduce the necessary relationship between incoming wind velocity and optimum exit velocity to derive maximum power. (05)

b) A windmill with multi blade rotor lifts 3.03 m³/ hr of water through a head of 28mts when the wind speed is 3.3m/s. calculate the power coefficient for a rotor diameter of 4.5 mtrs with transmission efficiency of 0.95 and pump efficiency of 0.75. (03)

c) A NEG Micon *1000/54* wind turbine (1000-kW rated power, 54 mtr. Diameter) has cut -in wind speed of 4 *m/s*, rated wind speed 14 m/s. and a furling wind speed of 25m/s. If this machine is located in Rayleigh wind with an average speed of 10 *m/s*. find the following: (04)

  i.   How many h/yr is the wind below the cut-in wind speed?
  ii. How many h1yr will the turbine be shut down due to excessive winds?
  iii. How many kWh/yr will be generated when the machine is running at rated power?

Q. No5) **(12)**

a) Explain the basic integration issues faced by wind power system based on the requirements of consumer and wind form operators.

<div align="center">OR</div>

b) Describe briefly power control topologies of following wind turbines;

  i)   Fixed speed wind turbine
  ii) Variable speed wind turbine

<div align="center">*****************************</div>