

## GRD Assignment 4

Due 10 December 2025

### Direct use of geothermal resources part

**1a)** For a direct-use fish pond application, what are the two most significant sources of heat loss?

**1b)** What methods or strategies could be employed to reduce the heat losses in problem 1a?

**1c)** Plot the convective heat loss, as a function of wind velocity from 0 to 10 m/s, for a 5 m by 5 m pool. Assume that the air temperature is 5°C and the pool temperature is 35°C. Do the same calculation for an air temperature of 10°C.

**1d)** Plot how long it would take for the pool in problem 1c to drop by 5 degrees, as a function of wind speed, if its depth was 1 m? Assume heat loss from radiation, conduction, convection, and evaporation.

**1e)** Following from question 1d, assume a geothermal water resource of 40°C was available. Plot the flow rate necessary to prevent the pool temperature from dropping more than 5°C.

### EGS part

**2a)** How is an EGS project different from a conventional hydrothermal geothermal system?

**2b)** What are the benefits of an EGS system?

**3)** Describe the physical processes that distinguish hydro-shearing from hydro-fracturing. What is the benefit of using hydro-shearing over hydro-fracturing?

**4)** What are the factors that control seismic activity?

**5)** The potential EGS resource is very large. If you were an investor, what criteria would you use to determine where to first deploy this technology? Why?

**6)** Of the principal challenges faced by EGS, what, in your opinion, is the easiest to overcome? What is the hardest? Why?

**7)** What reservoir management strategies can be followed to reduce the amount of time needed to replenish the heat removed from a reservoir. Use Equation 13.6 to inform your discussion:

$$T_b = \frac{(\pi \times \gamma_t \times d^2 \times t)}{(3 \times \gamma_f \times v)}$$

where:

$T_b$  is the time (h)

$\gamma_t$  is the heat capacity (J/m<sup>3</sup>K) of the reservoir

$\gamma_f$  is the heat capacity of the fluid (J/m<sup>3</sup>K)

$d$  is the distance between wells (m)

$t$  is the reservoir thickness (m)

$v$  is the flow rate (m<sup>3</sup>/h)