



## PNGE 450 - Introduction Geothermal Reservoir Engineering (3740450)

2018/19 Spring

Syllabus

- Prerequisites** Good performance in PNGE 3XX courses, particularly 343/344 would be a good asset for this course
- Time & Place** Wed.: 08:40-11:40, Classroom T-112
- Instructor** Dr. Emre Artun • **Office** T-138 • **Phone** 3014 • **e-mail** artun@metu.edu
- Office hours** Wed. 15:40-17:30, or by appointment

**Content:** Classification of geothermal reservoirs, distribution and characteristics of geothermal resources. Physical aspects of hydrothermal systems. Assessment of geothermal resources. Well completion and warm-up, measurements during drilling; temperature log, the completion tests, pressure log. Flow testing. Well performance.

**Course Outcomes:** Having successfully completed the course, the student will be able to:

1. define the occurrence and geological aspects of geothermal resources
2. characterize and assess geothermal resources by incorporating available data from wells or surface waters
3. interpret well measurements and tests during and after drilling including static measurements, completion and flow tests, pressure transient analysis and tracer testing for re-injection
4. identify proper ways of utilization for geothermal resources by considering and evaluating its thermodynamic characteristics
5. be familiar with geothermal energy terminology, literature, and case studies.

### Outline & weekly schedule

Week	Topic	Reading & Activities
Week 1	1. Introduction to Geothermal Energy	
Week 2	2. Earth as a Heat Engine for Geothermal Energy	Glassley, Ch.2
Week 3-4	3. Thermodynamics of Geothermal Resources	Glassley, Ch.3, PS-1
Week 4-5	4. Assessment and Geochemistry of Geothermal Resources	Glassley, Ch.7
Week 6	5. Interpretations of Well Measurements	Grant and Bixley, Ch. 6
Week 7	<b>Midterm Exam-1</b>	Coverage: Topics 1-4
Week 8	6. Completion Test and Well Performance	Grant and Bixley, Ch. 7-8
Week 9	7. Reinjection, Tracer Testing and Interpretation	PS-2
Week 10	8. Pressure Transient Analysis	
Week 11	9. Direct Utilization: Heating/Cooling	Glassley, Ch.8,9
Week 12	<b>Midterm Exam-2</b>	Coverage: Topics 5-8
Week 13	10. Indirect Utilization: Power Generation	Glassley, Ch.10, PS-3
Week 14	Group Presentations (Each group will deliver a 15-min. presentation)	

### Reference Books

- Glassley, W.E. (2014). *Geothermal Energy: Renewable Energy and the Environment*, 2nd Edition, CRC Press, Boca Raton, Florida, USA. (Chapters 1-3,7,9-11)
- Grant, M., Bixley, P. (2011). *Geothermal Reservoir Engineering*, 2nd edition, Elsevier, Amsterdam, Netherlands. (Chapters 6-8)

### Course Policies

- **Grading Policy**  
2 Midterm exams: 22.5% each, 45% total  
Final exam: 35%  
Problem set assignments: 12%  
Term project (paper and presentation): 8%
- **Make-up exam:** No make-up exam/quiz will be given unless an official excuse is submitted.
- **Class announcements:** ODTUClass will be used regularly for postings and announcements with at least 24-hours notice. Therefore, students are responsible for checking for their ODTUClass/E-mail inbox everyday.
- **Assignments:** Assignments will be individually-assigned and group work will not be allowed. While discussion with the instructor and classmates are strongly encouraged, all of the work must be done individually. It is not allowed to use someone else's files or data at any step of the calculations. Copied projects will be penalized with a 'zero' grade, and disciplinary action may be taken.

- Conditions for NA grade:
  - failing to take at least 1 midterm examination
  - failing to take the final examination
  - failing to submit at least 50% of the assignments
- Attendance: Attendance will be taken and together with overall participation, it will be considered during letter-grading.
- Make-up exam: No make-up exam will be given unless an official excuse is submitted.
- Final Grading

If the class average for final grades is less than 69, curved grading is going to be utilized based on the overall grade distribution. Otherwise, the final grading will be based on the grade scale indicated in Article 24 of Academic Rules and Regulations for Undergraduate Education determined by the University which can be found in the following web page: <http://ncc.metu.edu.tr/ro/undergraduate-education-regulation>
- Other Policies:
  - Use of electronic devices, except calculators, and eating during lectures and exams are prohibited.
  - Students are expected to take notes during the class and bring their calculator and ruler for classwork examples.
  - Handouts/charts/classwork problems are distributed whenever applicable.

#### **Academic Integrity**

Please note that PNGE 450 adopts METU NCC's Academic Code of Ethics. When a breach of the code of ethics occurs (cheating, plagiarism, deception, etc.) a faculty member has several (non-exclusive) such as giving a 'zero' grade for the relevant exam, project, assignment, and/or a larger part or all of the coursework, giving options a failing letter grade for the course, or forwarding the case to the discipline committee. The METU NCC Academic Code of Ethics and its processes for dealing with academic integrity issues can be found at: [http://ncc.metu.edu.tr/sites/default/files/ETHICAL\\_RULES.pdf](http://ncc.metu.edu.tr/sites/default/files/ETHICAL_RULES.pdf)