Renewable Energy 1 – Solar & Geothermal (EG501J)

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1 Partial Syllabus (Geothermal Energy)

1. Concepts for geothermal energy and development of drilling technologies;
2. Economical viabiity of geothermal resources;
3. Different land geological structure including hard rock and high temperature/pressure conditions;
4. Geothermal power station footprint and its requirement.

2 Detailed Syllabus (Geothermal Energy)

Lecture 1: Geothermal Energy: General Overview of the Energy Mix

(a) World energy consumption and CO_2 emissions;
(b) Basics of power plants;
(c) Economics of geothermal energy;

Lecture 2: Geothermal Engineering – Part 1

(a) Engineering Thermodynamics
  (i) Production of Power from Heat
    A. Revision of the Carnot-engine cycle and the basic steam power plant;
    B. Rankine cycle;
  (ii) Refrigeration Cycles
    A. The Carnot refrigerator;
    B. The vapour-compression cycle;
    C. Heat pumps

Lecture 3: Geothermal Engineering – Part 2

(b) Fundamentals of exploration and production;
(b) Basic Designs;
(b) Economical considerations;
(b) Environmental Impact;

3 Timetable

Engineering Thermodynamics (EG3521)					
Week 30	Feb 03	12.00-13.00	Intro Lect 1.1	JG	KCG8
	Feb 04	09.00-10.00	Lect 1.2	JG	FN2
	Feb 06	12.00-13.00	Lect 1.3 + Tutorial 1	JG	MT4
Week 31	Feb 10	12.00-13.00	Lect 2.1	JG	KCG8
	Feb 11	09.00-10.00	Lect 2.2	JG	FN2
	Feb 13	12.00-13.00	–	–	No Lecture
Week 32	Feb 17	12.00-13.00	–	–	No Lecture
	Feb 18	09.00-10.00	Lect 2.3	JG	FN2
	Feb 20	12.00-13.00	Lect 2.4	JG	MT4
	Feb 20	09.00-10.00	Cont. Assessment 1	All	G3 St. Mary's
	Feb 21	16.00-17.00	Tutorial 2	JG	105 St Mary's (optional)
Week 33	Feb 24	12.00-13.00	Lect 2.5	JG	KCG8
	Feb 25	09.00-10.00	Lect 2.6	JG	FN2
	Feb 27	12.00-13.00	Tutorial 3	JG	MT4
	Feb 27	09.00-10.00	Cont. Assessment 2	All	G3 St. Mary's
	Feb 28	16.00-17.00	Tutorial 4	JG	105 St Mary's (optional)
Week 34	Mar 03	12.00-13.00	Lect 3.1	JG	KCG8
	Mar 04	09.00-10.00	Lect 3.2	JG	FN2
	Mar 06	12.00-13.00	Lect 3.3	JG	MT4
Week 35	Mar 10	12.00-13.00	Lect 3.4	JG	KCG8
	Mar 11	09.00-10.00	Lect 3.5	JG	FN2
	Mar 13	12.00-13.00	Tutorial 5	JG	MT4
	Mar 13	09.00-10.00	Cont. Assessment 3	All	G3 St. Mary's
	Mar 14	16.00-17.00	Tutorial 6	JG	105 St Mary's (optional)
Week 36	Mar 17	12.00-13.00	Lect 4.1	PH	KCG8
	Mar 18	09.00-10.00	Lect 4.2	PH	FN2
	Mar 20	12.00-13.00	Lect 4.3	PH	MT4
	Mar 20	09.00-10.00	Cont. Assessment 4	All	G3 St. Mary's
	Mar 21	16.00-17.00	Tutorial 7	PH	105 St Mary's NK10
Week 37	Mar 24	12.00-13.00	Lect 4.4	PH	KCG8
	Mar 25	09.00-10.00	Lect 4.5	PH	FN2
	Mar 27	12.00-13.00	Lect 4.6	PH	MT4
Week 41	Apr 22	09.00-10.00	Tutorial 8	PH	FN2
	Apr 24	12.00-13.00	Lect 5.1	PH	MT4
Week 42	Apr 29	09.00-10.00	Lect 5.2	PH	FN2
	May 01	12.00-13.00	Lect 5.3	PH	MT4
Week 43	May 06	09.00-10.00	CA Presentation 1	All	FN2
	May 08	12.00-13.00	CA Presentation 2	All	MT4
	May 08	09.00-10.00	CA Presentation 3	All	G3 St. Mary's
	May 09	16.00-17.00	CA Presentation 4	All	105 St Mary's
Week 44	May 13	09.00-10.00	Tutorial 9	PH	FN2
	May 15	12.00-13.00	Revision 1		MT4
	May 15	09.00-10.00	Revision 2		G3 St. Mary's
	May 16	16.00-17.00	Revision 3		NK 10 105 St. Mary's

Activity	**Weeks**	**N^o weeks**		
Lectures	30-37	8		19h
Lectures	41-42	2		03h
Total				**22h**
Tutorials	31-33, 35, 36, 41, 44	7	1h	**09h**
Cont. Assessment Activities	32, 33, 35, 36, 43	5	1h (in class)	**08h**

4 Assessment

(a) *First Attempt:* 1 three-hour Writtem Examination Paper (WEP, 80%) + Continuous Assessment (20%) + Problem Solving Exercise (01 CAS Mark, optional);

- CA comprises an oral presentation;
- PSE comprises solving a computational thermodynamic problem with the following deliverables: source code (Fortran, C, C++, Python or Matlab) + oral presentation. The PSE will be awarded as **either** 1 **or** 0 CAS mark.

(b) *Resit:* 1 three-hour writtem examination paper (WEP, 80%) + continuous assessment mark from the *first attempt* (20%) + Problem Solving Exercise (01 CAS Mark, optional);

(c) The final CAS mark (FCM) is calculated as:

$$FCM = \min\{20, 0.8 \times WEP + 0.2 \times CA + PSE\}$$

References

[1] M.J. Moran, H.M. Shapiro, D.D. Boettner, M.B. Bailey (2012) *Principles of Engineering Thermodynamics*, John Wiley & Sons, 7^{th} Edition.

[2] J.M. Smith, H.C. Van Ness, M.M. Abbott (2001) *Introduction to Chemical Engineering Thermodynamics*, McGraw-Hill Higher Education, 6^{th} Edition.

[3] H.C. Armstead (1978) *Geothermal Energy*, E.&F.N. Spon Ltd, 2^{nd} Edition.

[4] E. Huenges, P. Ledru (2010) *Geothermal Energy Systems: Exploration, Development and Utilization*, Wiley-VCH.

[5] R. DiPippo (2008) *Geothermal Power Plants: Principles, Applications, Case Studies and Environmental Impact*, Butterworth-Heinemann, 2^{nd} Edition.

[6] H.K. Gupta (1980) *Geothermal Resources: An Energy Alternative*, Elsevier.