

## **MOOC 课程信息 MOOC course information:**

Five day workshop stressing energy concepts, theory, and principles. Each day is composed of 4 sessions, two in the morning and two in the afternoon. One or two sessions each day is devoted to a case study that includes “hands-on” computation of emergy or simulation of models to reinforce lecture material and extend understanding of systems concepts.

### ***DAY 1: WHAT ARE EMERGY, EXERGY? PRIMARY, SECONDARY AND TERTIARY GLOBAL RENEWABLE SOURCES***

#### ***Morning 1 – Introduction***

- Value and wealth
- Systems of value
- Brief overview of Emergy Accounting

#### ***Morning 2 - Systems and Systems Diagrams***

- Systems concepts
- Introduction energy systems diagramming language
- Quantitative diagramming and picture mathematics

[\*Assignment 1: System diagramming\*](#)

#### ***Afternoon 3 - Emergy & Exergy***

- Introduction to emergy, transformity, specific emergy, Maximum Empower Principles, hierarchical organization, quality.
- Introduction to exergy, exergoecology, thermoecological costs, extended exergy analysis, ecological footprint.

#### ***Afternoon 4 - Geobiosphere Emergy Baseline***

- Geobiosphere Emergy Baseline, Global web
- Computation of primary, secondary and tertiary global renewable sources
- Accounting principles to avoid double counting

[\*Assignment 2: Compute UEVs Global Secondary & Tertiary Sources\*](#)

### ***DAY 2 – CONCEPTS OF EMERGY ACCOUNTING***

#### ***Morning 5 - Emergy of Materials, Energy, and Finished Products***

- Material Cycles
- UEVs of non-renewable fossil fuels
- UEVs of minerals and metals
- UEVs of slowly renewables
- UEVs of some quaternary products

#### ***Morning 6 - Static Emergy Accounting***

- Emergy algebra
- Emergy evaluation procedure
- Static calculation

[\*Assignment 3: Static Emergy Accounting\*](#)

#### ***Afternoon 7 - Dynamic Emergy Accounting***

- Simulation of emergy
- Network analysis of emergy
- Biodiversity

#### ***Afternoon 8 – Case Study: Emergy Evaluation Procedure***

- Emergy Evaluation of a system that yields a UEV

[\*Assignment 4: Dynamic Emergy Accounting using Excel Solver\*](#)

### ***DAY 3 – EMERGY SYSTEMS CONCEPTS***

#### ***Morning 9 – Emergy and the Economy***

Emergy, economy and money  
Emergy money ratio  
Value Added  
Emergy benefit to purchaser  
Emergy exchange ratio  
Trade  
National Debt

***Morning 10 - National Emergy Accounting***

Emergy evaluation of nations  
Introduction to the National Emergy Accounting Database (NEAD)  
Efficiency of nations  
Depletion of natural capital

[Assignment 5: Exercises with  
NEAD](#)

***Afternoon 11 – Case Study: Emergy Evaluation of a Nation***

Work with excel table of a national analysis

***Afternoon 12 – Emergy and Urban Systems***

Understanding urban systems  
Settlement location  
Urban Hierarchy  
Central place theory

***DAY 4 – APPLICATIONS OF EMERGY METHODOLOGY***

***Morning 13 - Emergy and ecosystems***

What is a ecosystem?  
GPP & NPP  
Succession  
Emergy of ecosystem components  
Restoration

***Morning 14 – Ecosystem Services and Natural Capital***

What are ecosystem services?  
What is natural capital?  
Case studies  
Natural capital degradation and sustainability

[Assignment 6: Estuarine Emergy Signature](#)

***Afternoon 15 - Landscape Development Intensity Index***

What are ecosystem services?  
What is natural capital?  
Case studies  
Natural capital degradation and sustainability

***Afternoon 16 – Environmental Impact Assessment***

Phosphate mining restoration  
Power plant and estuarine cooling  
Florida Everglades restoration

[Assignment 7: Emergy evaluation of estuarine losses](#)

***DAY 5 – ALTERNATIVES***

***Morning 17 – Environmental Impact Assessment II***

Marine Oil Spills static evaluation,  
Marine Oil Spills dynamic evaluation

***Morning 18 – Energy Evaluation of Energy Alternatives***

Nonrenewable energy sources  
Net energy  
Renewable energy sources  
Plastic or paper bags?  
Disposable or cloth diapers?

*Assignment 8: Compute Net Energy*

***Afternoon 19 - Recycle***

Evaluation of recycled materials  
Evaluation of aluminum  
Evaluation of waste food by-products

***Afternoon 20 – Simulation Modeling***

Combined models of humanity and nature  
Simple growth models  
Production/Respiration  
Limiting factors  
Models with economic and energy constraints  
Population models  
Ecosystem models

*Assignment 9: Simulation using EXCEL*