Design with Constructal theory

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Course Abstract

The course introduces the meaning of the Constructal Theory. It shows that the principle that generates design and evolution in nature, the Constructal Law, explains that every live system tends to generate shape and structure that facilitates its movement. It also addresses the method to apply the Constructal Law: Constructal Design. The steps of this simple and effective method are shown and explained in detail: the flow system, the constraints, the degrees of freedom, the performance indicator, and several examples of application in the search for best shapes and structures in Engineering. Some essential topics in the Evolution as Physics phenomenon are also addressed.

Date	Contents	Reference
07/09 03:00-05:00 p.m. **Tuesday**	Constructal theory, Constructal law, and Constructal design. Vascularization, and Svelteness. Fluid Flow: Internal Flow and External Flow. Heat Transfer: Conduction and Convection. Imperfection.	**DCT**
09/09 03:00-05:00 p.m. **Thursday**	Simple Flow Configurations. Flow between two points. River Channel Cross-Sections. Internal Spacings for Natural and Forced Convection.	**DCT**
14/09 03:00-05:00 p.m. **Tuesday**	Tree Networks for Fluid Flow. Optimal Proportions: *T*- and *Y* -Shaped Constructs. Performance versus Freedom to Morph; Asymmetry.	**DCT**
16/09 03:00-05:00 p.m. **Thursday**	Configurations for Heat Conduction: the Elemental volume. Trees for Cooling a heat generating plate. Tress for Colling a Disc-Shaped Body. Conduction Trees with Loop.	**DCT**
21/09 03:00-05:00 p.m. **Tuesday**	The birth of flow. The birth of design. Witnessing Evolution. Why hierarchy reigns. The fast and long meets the slow and short.	**DN**

	The design of Academia.	
23/09 03:00-05:00 p.m. **Thursday**	The Life Question. What All the World Desires. Wealth as Movement with Purpose. Technology Evolution. Sports Evolution. The death question. Life and evolution as Physics.	**PL**
Virtual Room	DIMSAI virtual aula	TEAMS platform

Objectives

- Introduce students to the main concepts of Constructal theory
- Teach how to apply the Constructal Design Method to determine configurations that facilitate the flow.
- Present examples and case studies that allow students to practice the acquired knowledge.

References

1) Bejan, A. (2000) Shape and Structure, from Engineering to Nature, Cambridge University Press.

2) **Bejan, A. and Lorente S. (2008) Design with Constructal Theory, Wiley, Hoboken, New Jersey. (DCT)**

3) Rocha, L. (2009) Convection in Channels and Porous Media, Analysis, Optimization and Constructal design, VDM Verlag Dr. Muller, Deutschland.

4) **Bejan, A., and Zane, J. P., 2012, Design in Nature, Doubleday, New York. (DN)**

5) Rocha, L. A. O., Lorente, S., and Bejan, A., 2013, Constructal Law and The Unifying Principle of Design, Springer-Verlag, New York.

6) **Bejan, A., 2016, The Physics of Life, St. Martins, Press, New York City, USA. (PL)**

7) Miguel, A. F. and Rocha, L. A. O., 2018, Tree-Shaped Fluid Flow and Heat Transfer, Springer, Switzerland.

8) Bejan, A., 2020, Freedom and Evolution, Springer, Switzerland.

Websites – Constructal Law

https://g1.globo.com/ciencia-e-saude/noticia/a-lei-da-fisica-que-controla-discretamente-sua-vida-e-pode-ajudar-a-melhora-la.ghtml

https://www.fi.edu/laureates/adrian-bejan

https://constructal.org/

https://goo.gl/UnhXkY - Thermodinamic timeline (Umit)

https://umitgunes.net/12th-constructal-law-second-law-conference

https://umitgunes.net/en/timeline

Videos Constructal law

https://www.youtube.com/watch?v=tgEBTPee9ZM (Villanova University)

https://www.youtube.com/watch?v=GMYr-H70VYo&t=319s (Did God criate the world)

https://www.youtube.com/watch?v=s9eB_i-hK94 (Duke University)

https://www.youtube.com/watch?v=kaBAxrH6Q4o (why time flies)

https://youtu.be/m4lJ4EylvwI (Nature, Humans, Purpose)

https://youtu.be/Zeti2tDcsP0 - Bejan interview - pandemic

https://youtu.be/GnnxOfUhSnQ - Thermodynamics 2.0

https://www.youtube.com/watch?v=ODlsqB0SFqc – Bejan's interview in Spanish

https://mail.google.com/mail/u/0/#inbox/FMfcgxwLsJvLTrshqTMvfDTGcGzmNHpr?projector=1 - English interview