**JEE 688 Data Science for Environmental and Energy Studies**
**(JEE xxx Essential Concepts of Data Science for Environment and Energy)**
**(Main coordinator: Assoc. Prof. Dr. Kasemsan Manomaiphiboon)**
Version 23 May 2022

## 1. Course Description

This graduate-level course introduces essential elements of data science and its ecosystem, as motivated by their significance and utility in today-world applications, including environmental and energy issues. The course is designed to prepare students to be equipped not only with basic knowledge but initial familiarity to certain data tools and open data to necessarily enhance their academic research and future career. The course begins with an overview of data science and the world of data, followed by data attributes and conventions. The backbone of the course is dedicated to data analytics, which covers data handling & wrangling, statistics, and predictive methods. Real-world data-related applications are illustrated for additional perspectives. The course employs a mixed approach with emphasis on lectures, complemented by tool-based demonstration and a mini class project.

## 2. Target Knowledge, Skills, and Abilities (KSA)

Knowledge: Essential elements of data science and its ecosystem
Skills: Initial familiarity to selected standard open-source tools and open data
Abilities: Data handling and data

## 3. Target group of students

a. PhD and MS students at JGSEE
b. (Optional) PhD and MS students at KMUTT in engineering and science
c. (Optional) Non-degree interested persons

## 4. Pre-requisites

None

## 5. Course Learning Outcomes [Indicate the alignment of CLOs with the PLOs]

Students are expected to be able to
CLO1: Understand the essential elements of data science and its ecosystem
- ECS aligned: PLO2, PLO4
- SES aligned: PLO2, PLO3

CLO2: Develop initial familiarity with selected open-source data tools
- ECS aligned: PLO2
- SES aligned: PLO2

CLO3: Conceptualize the utility of data science and open data in environment and energy
- ECS aligned: PLO3, PLO6

- SES aligned: PLO5, PLO6

**6. Method of Teaching and Learning**

Online, on-site, or hybrid (all applicable)

**7. Course Outline and Organization**

Open every semester or one semester annually, depending on if assigned core or elective

**Module 1: Essential concepts**

MLO1: Understand the essential elements of data science and its ecosystem
- ESC aligned: LO2.6, LO4.1
- SES aligned: LO2.2, LO3.0

MLO2: Develop initial familiarity with selected open-source data tools
- ESC aligned: LO2.2
- SES aligned: LO2.2

MLO3: Conceptualize the utility of data science and open data in environment and energy
- ECS aligned: LO3.1
- SES aligned: LO6.0

| Lecture | Instructor | Teaching Period |
|---|---|---|
| Lecture 1: Data science, data analytics, and big data | KM (JGSEE) | 1 week |
| Lecture 2: Data types and formats | KM (JGSEE) | 1 week |
| Lecture 3: Space-time convention | KM (JGSEE) | 1 week |
| Lecture 4: R, Python, and QGIS in a very nutshell | KM (JGSEE) / Other | 1 week |
| Lecture 5: Data operation | KM(JGSEE) | 1 week |
| Lecture 6: General and spatial statistics | KM (JGSEE) | 1 week |
| Lecture 7: Database and query | KM (JGSEE) | 1 week |
| Lecture 8: Data reduction | KM (JGSEE) | 1 week |
| Lecture 9: Time series | KM (JGSEE) | 1 week |
| Lecture 10: Causal relationship | KM (JGSEE) | 1 week |
| Lecture 11: AI and machine learning | KM (JGSEE) / Other | 1 week |
| Lecture 12: Data visualization | KM (JGSEE) | 1 week |

**Module 2: Real-world perspectives**

MLO1: Conceptualize the utility of data science and open data related to environment and energy
- ECS aligned: LO6.1
- SES aligned: LO5.0

| Lecture | Instructor | Teaching Period |
|---|---|---|
| Lecture 13: IoT and smart city/energy/farming | Other | 1 week |
| Lecture 14: Cluster/cloud computing and data storage | Other | 1 week |
| Lecture 15: Space-based data (climate, air quality, waste, plastic, biomass, solar, wind, wave, and hydropower) | KM (JGSEE) / Other | 1 week |
| Lecture 16: Mini class project submitted and examination | KM (JGSEE) | 1 week |

**8. Evaluation Methods**

a. Take-home examination, given in the end of Module 2 (70%)

b. Mini class project submitted in the end of Module 2 (20%)
c. Class participation throughout the semester (10%)

**9. Guided References/Resources**


a. Lecture notes of the main instructor.
b. Kotu V, Deshpande B (2019) Data Science: Concepts and Practice. Morgan Kaufmann (Elsevier).
c. Crawley MJ (2012) The R Book. Wiley.