

21 Tampines Avenue 1

Singapore 529757

SCHOOL OF ENGINEERING

Engineering Analytics and Machine Learning Syllabus

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Review/Approval

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| **Rev** | **Effective Date** | **Originator (Name & Initial)** | **Approval (Name & Initial)** |
| 1/2018 | May 2018 | Teo Kok Keong | Calaiselvy |
|  |  | Section Head/CEN | Course Manager/CEN |

#### TEMASEK POLYTECHNIC

**SCHOOL OF ENGINEERING**

1. **SUBJECT RUBRIC**

|  |  |
| --- | --- |
| Subject Title | : Engineering Analytics and Machine Learning |
| Subject Provider | : Diploma in Computer Engineering (CEN) |
| Diploma/s Offering Subject | : Specialist Diploma in Industrial Internet of Things (IIOT)  : Specialist Diploma in Industrial Internet of Things (IIOT) (Earn and Learn Programme) |
| Modular / Post-Diploma Certificate | : Post-Diploma Certificate in Engineering Analytics |
| Type of Subject | : Not applicable |
| Subject Code | : ECSE202 |
| Credit Units | : 4 |
| Level No. | : Not applicable |
| Total Curriculum Hours | : 60 hrs |
| Pre-requisite/s Needed | : Nil |
| Pre-requisite for Other Subjects | : Nil |
| Co-requisites | : Nil |

1. **SUBJECT AIMS AND SYNOPSIS**

**2.1 Aims**

This subject aims to equip students with the knowledge and skills to:

* apply the processes needed to perform analysis on engineering data.
* present results in the form of visualization analysis.
* apply machine learning algorithms on engineering data.

**2.2 Synopsis**

This subject provides coverage of the knowledge of concepts and skills in the tools and processes used in data analytics of large amounts of engineering data. It encompasses the various stages of data analytics, from gathering the data, asking the right questions, to analyzing and interpreting data, identifying patterns and trends and making use of machine learning and predictive models to make intelligent and actionable recommendations for improvement in engineering systems, such as, optimization of energy usage and improvements to manufacturing processes.

1. **SUBJECT SCOPE AND LEARNING OUTCOMES**

| General Learning Outcomes | Specific Learning Outcomes | Topics/Themes |
| --- | --- | --- |
| **Students should be able to** | | |
| 1. Perform data analysis using data analytics toolbox | * 1. Apply appropriate data types and structures to manipulate data.   2. Develop basic methods and functions for data handling. | Data Analytics Toolbox |
| 1. Perform data gathering and pre-processing of data | * 1. Identify the different sources for various types of data and their characteristics.   2. Perform data cleaning and pre-processing on a data 7set.   3. Explain the impact of quality of data to the analysis process. | Data Gathering |
| 1. Conduct exploratory data analysis and visualization techniques | * 1. Apply basic methods to analyse data for correlation, patterns and related parameters.   2. Use the appropriate type of plots to visualize different types of data.   3. Interpret data based on the plots.   4. Identify relations and trends between data variables. | Data Analysis and Visualization |
| 1. Perform regression analysis on data | * 1. Explain the various methods of regression analysis and how they can be used.   2. Apply regression models on data variables.   3. Interpret the outcomes of regression models. | Regression and Predictive Analytics |
| 1. Perform machine learning algorithms for predictive analysis | * 1. Explain the rationale for machine learning.   2. Apply machine learning methods and analysis on engineering data sets.   3. Interpret results of machine learning algorithms. | Machine Learning Models and Algorithms |

1. **Learning And Teaching Methods**

Lessons are conducted in learning spaces with required software tools installed in the students’ computers. The subject will be delivered through laboratory practices and bite-sized lectures.

The theoretical concepts are delivered in bite-sizes and are interspersed with laboratory work to reinforce those concepts.  Such bite-size interspersed learning enables students to manage their learning as well as to reinforce their understanding of the challenging concepts.

Online learning will be planned for part of the topics to develop students’ self-directedness in learning.

Project work is included to enable students to apply and integrate the knowledge and skills acquired to analyse data based on a given data set and demonstrate the importance of ethics and reproducibility of studies in Data Analytics.

1. **FORMATIVE ASSESSMENT**

Formative assessment will be on-going through various methods. Continual feedback will be given by the tutor to the students via laboratory practices.

Students can review their understanding of a topic by attempting the on-line quizzes. Feedback will be provided for wrong answers. The student is allowed to attempt the quiz again to improve their understanding.

Students are given opportunities for consultation and to post questions to close learning gaps. During assignment and project, interim progress checks will be carried out and feedback given to students.

1. **SUMMATIVE ASSESSMENT**

**6.1 Assessment Methods**

Continuous assessment is carried out throughout the semester in various combinations of the following assessment components: class participation, knowledge assessment, skills assessment and project work. Class Particiaption measures preparedness, efforts and participation in the class. Written test is used as a form of knowledge assessment to test students’ level of understanding of the concepts learned. Assignment is used as a form of skills assessment to assess on students’ ability to apply the skills acquired during the laboratory work to present their data analysis using visualization techniques and machine learning methods. Project work assesses students’ ability to put together the skills acquired to solve a given problem using the tools necessary for data analysis.

**6.2 Assessment Scheme**

|  |  |
| --- | --- |
| Assessment | **Weightages** |
| Continuous Assessment  * Class Participation * Written Tests * Assignments * Project | 100 % |
| Individual Component | >= 80 % |
| Group Component | <= 20 % |

1. **SCHEME OF WORK**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Topics / Assessment | | Learning and Teaching Methods | | Hours |
| Laboratory / Project  (Hours) | E-learning  (Hours) |
|  | **Topics** | | | |
| 1. Data Analytics Toolbox | | 36 |  |  |
| 2. Data Gathering | |  |  |
| 3. Data Analysis and Visualization | | 18 | 54 |
| 4. Regression and Predictive Analytics | |  |  |
| 5. Machine Learning Models and Algorithms | |  |  |
| **Sub-Total** | | **36** | **18** | **54** |
| **Assessment / Revision** | | | | |
| Assignment and Project Presentations, Written Test | | - | | 6 |
| TOTAL | |  | | **60** |

1. **LEARNING RESOURCES**

Larson, R. & Farber, E. (2012). *Elementary Statistics – Picturing the World* (5th ed.). Boston, MA: Pearson Prentice Hall.

Triola, F. (2014). *Elementary Statistics* (12th ed.). Harlow, England: Pearson Education.

Fabio, N. (2015). *Python data analytics : data analysis and science using Pandas, Matplotlib and the Python programming language.* New York, NY : Apress.

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Prepared by: Teo Kok Keong

### Section Head/CEN

Approved by: Calaiselvy

Course Manager/CEN

Date: February 2018

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# DEVELOPMENTAL HISTORY

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| **Rev** | **Proposed By** | **Approved By** | **Approval Date** | **Effective Date** | **Remarks** |
| 1/2018 | Teo Kok Keong | Calaiselvy | Apr 2018 | Oct 2018 | Initial Release  (Senate Ref. No. SEN132(2017)) |