Subject Description Form

Subject Code	CSE38900
Subject Title	Quantitative Methods for Engineers
Credit Value	3
Level	3
Pre-requisite	AMA1131 Calculus or AMA1130 Calculus for Engineers AMA2131/AMA2308 Mathematics for Engineers
Objectives	To provide the basic tools of mathematics and fundamental concepts to enable the students to formulate problems in statistical terms in civil engineering and sustainable development, and to apply statistical tools for their interpretation of data.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. summarize and present information effectively from data; b. apply the fundamentals of mathematics and science to formulate problems and obtain cost-effective solutions in civil engineering and sustainable development; c. design and carry out proper statistical tests and interpret the results for evaluation of problems in civil engineering and sustainable development; d. appreciate probabilistic nature of engineering/scientific problems and develop ability to quantify risk; e. integrate knowledge across different subject domains, including structures, fire safety, geotechnics, hydraulics, environmental and transportation engineering when trying to achieve objectives; f. communicate solutions logically and lucidly through calculation, sketch, drawing and in writing.
Subject Synopsis/ Indicative Syllabus	1. Techniques for analysis of experimental data, field data and meteorological data such as concrete compressive strengths, traffic volumes, wind velocities, wave heights, earthquake magnitudes and frequencies: first moment and second moment, locations and spread, outliers, scatter plots, box plots, frequency distribution and sample size required. Distributions of experimental results, measured data and meteorological data: normal distribution (concrete cube and traffic flow data), lognormal distribution (flood and travel time data), Weibull distribution (wind data). Sampling distribution and estimators. Goodness-of-fit test.

<table>
<tr><td></td><td>Correlation and regression analysis, coefficients and residuals. Correlation between collected data such as traffic speed, runoff and precipitation for river basin, void ratio and compression index of soils: regression models, coefficient of determination, prediction intervals. General linear model, multiple regression. ANOVA applied to regression. Identification of long term trend and contributing factors

2. Hypothesis testing and tests of significance. p values, power of a test. Mean exceeding standards. Implications of change of mean and standard deviation with time. Inference of two populations. Comparison of environmental quality at different time and different locations, t-test. Inference of more than two populations. One-way ANOVA. Two-way ANOVA. Randomized block. Chi square test. Checking normality of data. Contingency table.</td></tr>
<tr><td>Teaching/Learning Methodology</td><td>Emphasis is placed on a pro-active learning approach. Fundamental knowledge will be introduced in the lectures, with interspersed questions, exercises and quizzes for class discussion and after class self study. Students will be expected to read up, do exercises and reflect critically on the material covered in class. A companion web site-cum-discussion forum will be available to facilitate questioning and discussion. Optional tutorial sessions (1 hour per alternative week) can be arranged to cater for diverse learning needs on request.</td></tr>
<tr><td>Assessment Methods in Alignment with Intended Learning Outcomes</td><td>
<table>
<tr><td rowspan="2">Specific assessment methods/tasks</td><td rowspan="2">% weighting</td><td colspan="8">Intended subject learning outcomes to be assessed (Please tick as appropriate)</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td>d</td><td>e</td><td>f</td><td></td><td></td></tr>
<tr><td>1. Assignments</td><td>30</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td><td></td><td></td></tr>
<tr><td>2. Examination</td><td>70</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td><td></td><td></td></tr>
<tr><td>Total</td><td>100 %</td><td colspan="8"></td></tr>
</table>
Students must attain at least grade D in both coursework and final examination (whenever applicable) in order to attain a passing grade in the overall result.

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:
Assignments - Problem solving teaches students how to carry out</td></tr>
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<tr><td></td><td colspan="2">statistical tests and interpret the results. Real life data set given in assignments help students learn how to explore, summarize and present data. It also enables students to formulate engineering/scientific problems and to obtain solutions to problems formulated.

The final examination tests how much the students has learnt in this module. It reinforces and assesses the learning outcomes.</td></tr>
<tr><td rowspan="7">Student Study Effort Expected</td><td>Class contact:</td><td>Average hours per week</td></tr>
<tr><td>▪ Lectures / Tutorials</td><td>3 Hrs.</td></tr>
<tr><td>Other student study effort:</td><td></td></tr>
<tr><td>▪ Assignments</td><td>2 Hrs.</td></tr>
<tr><td>▪</td><td></td></tr>
<tr><td>▪ Self Study</td><td>4 Hrs.</td></tr>
<tr><td>Total student study effort</td><td>9 Hrs.</td></tr>
<tr><td>Reading List and References</td><td colspan="2">Essential References

Navidi, W. S., Statistics for Engineers and Scientists, 5th ed., McGraw-Hill, 2020.

Supplementary References
Keller G., Thomson, Statistics for Management and Economics, 11th edition, Cengage Learning, 2018.
D.S.Wilks, Statistical Methods in Atmospheric Sciences, 4th, ed., Academic Press, 2019.</td></tr>
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