Subject Description Form

Subject Code	CSE39284
Subject Title	Quantitative Methods for Environmental Studies
Credit Value	3
Level	3
Exclusion	CSE284 Quantitative Methods for Environmental Studies
Objectives	To provide the basic tools of mathematics to enable the students to formulate Environmental and Sustainable Development problems in statistical and analytical terms, and to apply these tools for their successful solution.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Understand the fundamentals of logic and statistics; b. Apply such fundamentals to explore, summarizing and presenting data so as to identify problems in environmental and sustainable development (ESD) using statistical methods; c. Design and carry out proper statistical tests and interpret the results for ESD problems; d. Critically assess the validity of information encountered in sciences and everyday life; e. Carry out statistical tests using computer software; f. Find and interpret solutions for first and second order differential equations; g. Communicate logically and lucidly in mathematical language and in English writing.
Subject Synopsis/ Indicative Syllabus	1. Fundamentals: Environmental data and long term monitoring, basic principles of air and meteorological monitoring. 2. Techniques for reporting air quality and meteorological data: locations and spread, outliers; scatter plots, box plots, frequency distribution. 3. Distributions of environment and ecology data, normal distribution (demographic data), log-normal distribution (air pollutant data), Weibull distribution (wind data), estimators. 4. Comparison of data collected at different sites: 1. with normal distributed data): one-sample *t*-tests, *p*-values, significance level, paired *t*-tests, two-sample *t*-tests; one-way ANOVA, *F*-test. 2. with non-normal distributed data): Wilcoxon rank sum test, Wilcoxon sign rank sum test. 5. Correlation between different pollutants, between different locations, climate change, long term trend and its p-value, impact of economic growth on regional air quality, meaning of *R*-squared, prediction intervals, residual. 6. Variability of greenhouse gases at different timescales, diurnal and seasonal variations, moving averages, deseasonalizing, autocorrelation, autoregressive model.

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<tr><td></td><td>7. Application of calculus to 2-D and 3-D problems in environmental problems. Differential calculus of functions of several variables. Partial derivatives. Chain rule, Taylor's formula. Integration, line and double integrals.

8. Modeling of Indoor Air Quality: First order differential equations, Separable differential equations, exact differential equations, linear differential equations. Exponential decay of indoor air pollutants and air cleaning device. Growth of bacteria and population.

9. Modeling of water and air diffusion: Gausssian dispersion equation. Linear second order differential equations. Homogeneous equations with constant coefficients. Complex exponential function. Non-homogeneous equations. Solution by undetermined coefficients and by variation ofparameters.</td></tr>
<tr><td>Teaching/Learning Methodology</td><td>Basic concepts and theory are delivered through lectures. Exercises will be given weekly as home work to develop philosophical and conceptual thinking rather than recognise and recall.

Emphasize on practice. Real life environmental examples will be given and explained during tutorials.

Scoring rubrics will be explained. The scoring rubrics will remind students different outcomes which are expected from them.

One mini-project will be given to develop all-roundedness. The project report and power point presentation can help students to develop their communication skills, develop lifelong learning skills and enhance their own personal development.</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="7">Intended subject learning outcomes to be assessed</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td>d</td><td>e</td><td>f</td><td>g</td></tr>
<tr><td>1.Assignments</td><td>30</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></tr>
<tr><td>Total</td><td>100</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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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.
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<tr><td></td><td colspan="2">Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Assignments - Problem solving teaches students how to carry out statistical tests and interpret the results. Real life data set given in assignments help students learn how to explore, summarize and present data.

Mini-projects take the homework to deeper dimensions. It teaches students how to formulate problems, search for appropriate data, think independently and hence develop lifelong learning skills. The project report and powerpoint presentation will help the student to develop his written and oral English.

The final examination tests how much the students has learnt in this module.</td></tr>
<tr><td rowspan="7">Student Study Effort Expected</td><td></td><td>Average hours per week</td></tr>
<tr><td>Class contact:</td><td></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>3 Hrs.</td></tr>
<tr><td>▪ Self Study</td><td>3 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">Statistical methods in atmospheric sciences, 3rd ed., D.S.Wilks, Academic Press, 2011.

Advanced Engineering Mathematics, 10th ed., E Kreyszig, Wiley, 2011.

Navidi, W. S., Statistics for Engineers and Scientists, 4th ed., McGraw-Hill, 2015.

Statistics for management and economics, 10th edition, Keller G., Thomson, 2014.</td></tr>
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