Subject Description Form

Subject Code	CSE38300
Subject Title	Introduction to Analytical and Quantitative Methods for Civil Engineering
Credit Value	3
Level	3
Pre-requisite	CSE20302 Engineering Analysis and Computation
Objectives	To provide the basic tools of mathematics and fundamental concepts to enable the students to formulate civil engineering problems in analytical and statistical terms, and to apply these tools for their feasible solution.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. summarize and present information effectively from data; b. design sampling plans for experiments and surveys; c. select and construct proper statistical models for engineering problems; d. apply the fundamentals of mathematics and science to formulate problems and obtain solutions in civil engineering; e. critically analyze and interpret the models formulated and solutions obtained to support the synthesis of logical and cost-effective solutions; f. integrate knowledge across different subject domains, including structures, geotechnics, hydraulics, environmental and transportation engineering when trying to achieve objectives; g. 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. (2 weeks) 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. (2 weeks) Correlation between collected data such as traffic speed, runoff and precipitation for river basin, void ratio and

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<tr><td></td><td>compression index of soils: regression models, coefficient of determination, prediction intervals, residual. (2 weeks)

2. Partial differential formulation of civil engineering problems: Laplace equation, steady-state seepage, potential flow, solution by method of separation of variables. Diffusion equation, heat conduction, consolidation equation, convection term in diffusion problems, Fourier series and transform, Laplace transform. Wave equation, vibration of a string, principle of minimum potential energy for the equilibrium of structures, vibration of beams, orthogonality of mode shapes. (7 weeks)</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>g</td><td></td></tr>
<tr><td>1. Assignments</td><td>20</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td><td></td></tr>
<tr><td>2. Mini-project</td><td>10</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td><td></td></tr>
<tr><td>3. 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>
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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.

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. It also enables students to formulate engineering problems in mathematical models and to obtain solutions to problems formulated.</td></tr>
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<tr><td></td><td colspan="2">Mini-project takes 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 will help the student to develop his written 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>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>1.69 Hrs.</td></tr>
<tr><td>▪ Mini projects</td><td>0.31 Hrs.</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.
William E. Boyce, Richard C. Diprima., Elementary Differential Equations and Boundary Value Problems, 11th Ed., John Wiley & Sons Inc., 2017.
Zill D.G. and Cullen M.R., Differential Equations with Boundary-Value Problems. 9th ed., Cengage Learning, 2018.

Supplementary References

Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons Inc, 2011
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.
C.H. Edwards and D.E. Penney, Differential Equations and Boundary Value Problems: Computing and Modeling, 5th ed., Pearson Education, 2019 .
G.F. Simmons and S.G. Krantz, Differential Equations: Theory, Technique and Practice, 2nd ed., McGraw-Hill, 2015.</td></tr>
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