Subject Description Form

Subject Code	AMA513
Subject Title	Design and Analysis of Experiments
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	To elaborate the principles, need and planning of experimental designs appropriate in industrial, engineering, managerial and scientific research. To broaden and develop the scope of analysis techniques in both response comparison and optimization. To address the development of efficient and quality test strategies. To familiarize students with advanced experimentation tools for quality improvement.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: (a) Apply the basic concepts and principles of experimental design appropriately in industrial, engineering, managerial and scientific research. (b) Formulate and identify the appropriate model for the experiment. (c) Identify the sources of errors in the design of experiments. (d) Apply the techniques of analysis of variance in both response comparison and optimization. (e) Identify and describe fixed-effects, random-effects and mixed-effects models. (f) Apply advanced experimentation tools for quality improvement. (g) Report and summarize the results of the model for the experiment.
Subject Synopsis/ Indicative Syllabus	Objectives and Application: Objectives and applications of experiments, recognition of the problem, choice of factors and levels, selection of response variable, choice of design, experimentation, data analysis, recommendations. The principles: Randomization, replication, blocking, analysis of variance, presentation and interpretation of experimental results, hierarchal structure, random effects. Randomized Blocks and related Designs: randomized complete block design, Latin square, Graeco-Latin square. Incomplete Block Designs: Balanced designs, partially balanced designs, Youden squares. Multifactor Experiments: Factorial experiments, main effects and interaction effects, 2- and 3-level factorial experiments, Yates' algorithm, randomized blocks and Latin squares as multifactor designs.

<table>
<tr><td></td><td>Confounding and Fractional Replications: Confounding in 2- and 3-level experiments, partial confounding, fractional replications of 2- and 3-level experiments.

Response Optimization: Response surface methodology, first-order designs, second-order designs, optimal combination of factor levels, evolutionary operation.</td></tr>
<tr><td>Teaching/Learning Methodology</td><td>Both the theoretical and practical aspects of scientific experiments will be treated with equal importance. This will be reflected in the teaching approach and assessment method.

The use of computer packages such as MINITAB, SAS, SPSS and SYSTAT will be discussed and demonstrated. Students will be required to complete assignments in the form of case studies, preferably related to their daily work. The computation involved will be done using computer packages.</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 (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></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. Mid-term test</td><td>20%</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>3. Examination</td><td>50%</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="7"></td></tr>
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Continuous Assessment comprises of assignments and a mid-term test. A written examination is held at the end of the semester.</td></tr>
<tr><td>Student Study Effort Required</td><td>
<table>
<tr><td>Class contact:</td><td></td></tr>
<tr><td>▪ Lecture</td><td>26 Hrs.</td></tr>
<tr><td>▪ Tutorial</td><td>13 Hrs.</td></tr>
<tr><td>Other student study effort:</td><td></td></tr>
<tr><td>▪ Assignment</td><td>20 Hrs.</td></tr>
<tr><td>▪ Self study</td><td>78 Hrs.</td></tr>
<tr><td>Total student study effort</td><td>137 Hrs.</td></tr>
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Reading List and References	Montgomery, D.C.	Design and analysis of experiments, 7th Edition	Wiley, 2008
	Ross, P.J.	Taguchi Techniques for quality engineering, 2nd Edition	McGraw-Hill, 1996
	Hicks, C.R.	Fundamental concepts in the design of experiments, 5th Edition	Oxford University Press, 1999
	Barker, T.B.	Engineering quality by design: Interpreting the Taguchi approach	Marcel Dekker, 1990
	Barker, T.B.	Quality by experimental design 3rd Edition	Marcel Dekker, 2005
	Moen, R.D., Nolan, T.W. and Provost, L.P.	Improving quality through planned experimentation	McGraw-Hill, 1991