INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

MECHANICAL ENGINEERING

COURSE DESCRIPTOR

Course Title	**PROBABILITY AND STATISTICS**				
Course Code	AHS010				
Programme	B.Tech				
Semester	II	CSE | IT			
	III	ME | CE			
Course Type	Foundation				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	-	-
Chief Coordinator	Mr. J Suresh Goud, Assistant Professor				
Course Faculty	Ms. P Srilatha, Assistant Professor Ms. B Praveena, Assistant Professor				

I. COURSE OVERVIEW:

The course focuses on more advanced Engineering Mathematics topics which provide with the relevant mathematical tools required in the analysis of problems in engineering and scientific professions. The course includes probability, random variables, probability distributions, correlation, regression, sampling distribution, testing of hypothesis and analysis of variance. The mathematical skills derived from this course form a necessary base to analytical and design concepts encountered in the program.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	Basic principles of statistics

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Probability and Statistics	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✔	Videos
✘	Open Ended Experiments						

V. EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into five units and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

The emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	**Theory**		**Total Marks**
Type of Assessment	CIE Exam	Quiz / AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Presentation on real-world problems
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	2	Seminar
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	1	Term Paper

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Professional Skills:** To produce engineering professional capable of synthesizing and analyzing mechanical systems including allied engineering streams.	1	Seminar
PSO 2	**Software Engineering Practices:** An ability to adopt and integrate current technologies in the design and manufacturing domain to enhance the employability.	-	-
PSO 3	**Successful Career and Entrepreneurship:** To build the nation, by imparting technological inputs and managerial skills to become Technocrats.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Enrich the knowledge of probability on single random variables and probability distributions.
II	Apply the concept of correlation and regression to find covariance.
III	Analyze the given data for appropriate test of hypothesis.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AHS010.01	CLO 1	Understand the basic concepts of probability and random variables.	PO 1	3
AHS010.02	CLO 2	Analyze the concepts of discrete and continuous random variables, probability distributions, expectation and variance.	PO 1	3
AHS010.03	CLO 3	Use the concept of random variables in real-world problem like graph theory, machine learning, Natural language processing.	PO 1	3
AHS010.04	CLO 4	Apply the binomial distribution and poisson distribution to find mean and variance.	PO 2	2
AHS010.05	CLO 5	Understand binomial distribution to the phenomena of real-world problem like sick	PO 2	2

		versus healthy.		
AHS010.06	CLO 6	Use poission distribution in real-world problem to predict soccer scores.	PO 2	2
AHS010.07	CLO 7	Apply the inferential methods relating to the means of normal distributions.	PO 4	1
AHS010.08	CLO 8	Understand the mapping of normal distribution in real-world problem to analyze the stock market.	PO 4	1
AHS010.09	CLO 9	Explain multiple random variables and the covariance of two random variables.	PO 2	2
AHS010.10	CLO 10	Understand the concept of multiple random variables in real-world problems aspects of wireless communication system.	PO 2	2
AHS010.11	CLO 11	Calculate the correlation coefficient to the given data.	PO 1	3
AHS010.12	CLO 12	Understand the correlation and regression to the real-world such as stock price and interest rates.	PO 1	3
AHS010.13	CLO 13	Calculate the regression to the given data.	PO 1	3
AHS010.14	CLO 14	Understand the concept of sampling distribution of statistics and in particular describe the behavior of the sample mean.	PO 1, PO 2	3
AHS010.15	CLO 15	Understand the concept of estimation for classical inference involving confidence interval.	PO 2	2
AHS010.16	CLO 16	Understand the concept of estimation in real-world problems of signal processing.	PO 2	2
AHS010.17	CLO 17	Understand the foundation for hypothesis testing.	PO 1, PO 2	3
AHS010.18	CLO 18	Understand the concept of hypothesis testing in real-world problem to selecting the best means to stop smoking.	PO 1, PO 2	3
AHS010.19	CLO 19	Apply testing of hypothesis to predict the significance difference in the sample means.	PO 1, PO 2	3
AHS010.20	CLO 20	Apply testing of hypothesis to predict the significance difference in the sample proportions.	PO 1, PO 2	3
AHS010.21	CLO 21	Apply Student t-test to predict the difference in sample means.	PO 1	3
AHS010.22	CLO 22	Apply F-test to predict the difference in sample variances.	PO 1	3
AHS010.23	CLO 23	Understand the characteristics between the samples using Chi-square test.	PO 1	3
AHS010.24	CLO 24	Understand the assumptions involved in the use of ANOVA technique.	PO 4	1
AHS010.25	CLO 25	Understand the concept ANOVA to the real-world problems to measure the atmospheric tides.	PO 4	1

3 = High; 2 = Medium; 1 = Low

X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

CLOs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3												1		
CLO 2	3												1		
CLO 3	3												1		
CLO 4		2													
CLO 5		2													
CLO 6		2													
CLO 7				2											
CLO 8				1											
CLO 9		3											1		
CLO 10		2											1		
CLO 11	3														
CLO 12	3														
CLO 13	3														
CLO 14	3	2											1		
CLO 15		2													
CLO 16		2													
CLO 17	3	2											1		
CLO 18	3	2											1		
CLO 19	2	2											1		
CLO 20	3	1											1		
CLO 21	3														
CLO 22	3														
CLO 23	2														
CLO 24				2											
CLO 25				1											
CLO 26															

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO 1, PO 2, PO 4	SEE Exams	PO 1, PO 2, PO 4	Assignments	PO 4	Seminars	PO 2
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	PO 4						

XII. ASSESSMENT METHODOLOGIES - INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XIII. SYLLABUS

Unit-I	SINGLE RANDOM VARIABLES AND PROBABILITY DISTRIBUTION
Random variables: Basic definitions, discrete and continuous random variables; Probability distribution: Probability mass function and probability density functions; Mathematical expectation; Binomial distribution, Poisson distribution and normal distribution.	
Unit-II	**MULTIPLE RANDOM VARIABLES**
Joint probability distributions, joint probability mass, density function, marginal probability mass, density functions; Correlation: Coefficient of correlation, the rank correlation; Regression: Regression coefficient, the lines of regression, multiple correlation and regression.	
Unit-III	**SAMPLING DISTRIBUTION AND TESTING OF HYPOTHESIS**
Sampling: Definitions of population, sampling, statistic, parameter; Types of sampling, expected values of sample mean and variance, sampling distribution, standard error, sampling distribution of means and sampling distribution of variance. Estimation: Point estimation, interval estimations; Testing of hypothesis: Null hypothesis, alternate hypothesis, type I and type II errors, critical region, confidence interval, level of significance. One sided test, two sided test.	
Unit-IV	**LARGE SAMPLE TESTS**
Test of hypothesis for single mean and significance difference between two sample means, Tests of significance difference between sample proportion and population proportion and difference between two sample proportions.	
Unit-V	**SMALL SAMPLE TESTS AND ANOVA**
Small sample tests: Student t-distribution, its properties: Test of significance difference between sample mean and population mean; difference between means of two small samples. Snedecor's F-distribution and its properties; Test of equality of two population variances Chi-square distribution and it's properties; Test of equality of two population variances Chi-square distribution, it's properties, Chi-square test of goodness of fit; ANOVA: Analysis of variance, one way classification, two way classification.	
Text Books:	
1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons Publishers, 9th Edition, 2014. 2. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43rd Edition, 2012.	
Reference Books:	
1. T.K.V Iyengar, B.Krishna Gandhi, "Probability and Statistics", S. Chand & Co., 6th Edition, 2014. 2. G.C.Beri, "Business Statistics", Tata McGraw-Hill Publications, 2nd Edition, 2005. 3. Richard Arnold Johnson, Irwin Miller and John E. Freund, "Probability and Statistics for Engineers", Prentice Hall, 8th Edition, 2013.	

XIV. COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1	Describe the concept of Random variables and Contrast discrete Random variables and calculate the mean and variance of discrete Random variables	CLO 1	T1:22.5 R1:2.3
2	Recall the continuous probability function	CLO 2	T1:22.5 R1:2.4
3	Identify mathematical mean	CLO 2	T1:22.6 R1:2.6
4-5	Recall characteristics of the Binomial Distribution and find mean , variance	CLO 4	T1:22.7 R1:4.4
6-7	Recognize cases where Poisson Distribution could be appropriate model to find mean and variance	CLO 4	T1:22.7 R1:4.10
8-9	Apply Normal Distributions find the probability over a set of values, mean and variance	CLO 7	T1:22.8 R1:4.15
10	Apply probability distribution	CLO 9	T1:22.9 R1:5.4
11	Apply marginal probability density function	CLO 9	T1:22.9 R1:5.8
12-13	Recognize the limitation of correlation as a summary of bivariate data.	CLO 11	T1:23.10 R1:6.8
14	Interpret the correlation between the bivariate data by allotting ranks.	CLO 11	T1:23.10 R1:6.13
15-16	Define the concept of least squares estimation in linear regression	CLO 13	T1:23.9 R1:7.5
17	Estimate the linear model to a bivariate data	CLO 11	T1:23.10 R1:7.5
18	Recognize the multiple correlation of bivariate data	CLO 9	T1:23.10 R1:8.1
19	Recall the sampling distribution of the sample mean in general situation	CLO 14	T1:23.1 R1:9.2
20	Distinguish between a population and a sample and between parameters & statistics	CLO 14	T1:23.1 R1:9.4
21	Recall the sampling distribution and define standard error	CLO 14	T1:23.1 R1:9.9
22-23	Recall the sampling distribution of the sample mean in general situation	CLO 14	T1:23.1 R1:9.10
24-25	Interpret the confidence interval and confidence level	CLO 14	T2:27.5 R1:10.2
26	Understand the foundation for classical inference involving hypothesis testing and two types of errors possible	CLO 17	T2:27.7 R1:11.3
27	Explain level of significance confidence interval	CLO 17	T2:27.8 R1:11.6
28-30	Identify the confidence interval with single mean	CLO 19	T2:27.12 R1:11.7
31-32	Identify the confidence interval with difference between the mean	CLO 19	T2:27.12 R1:11.8
33-34	Identify the confidence interval with difference between the proportions	CLO 20	T2:27.12 R1:11.9
35-36	Identify the confidence interval with difference between the proportions	CLO 20	T2:27.12 R1:11.10
37-38	Recall the definition of a t-statistics in terms of statistics of sample from a normal distribution	CLO 21	T2:27.14 R1:12.3

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
39	State and apply the definition of F-distribution	CLO 22	T2:27.1 R1:12.7
40-41	State and apply the definition of χ^2 –Distribution	CLO 23	T2:27.17 R1:12.15
42	Apply Chi-square distribution	CLO 23	T2:27.18 R1:12.19
43-44	Apply One way classification	CLO 24	T2:27.19 R2:14.4
45	Apply Two way classification	CLO 24	T2:27.19 R2:14.5

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed Actions	Relevance with Pos	Relevance with Psos
1	To improve standards and analyze the concepts.	Seminars	PO 1	PSO 1
2	Conditional probability, Sampling distribution, correlation, regression analysis and testing of hypothesis	Seminars / NPTEL	PO 4	PSO 1
3	Encourage students to solve real time applications and prepare towards competitive examinations.	NPTEL	PO 2	PSO 1

Prepared By:
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