INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

MECHANICAL ENGINEERING

COURSE DESCRIPTOR

Course Title	**PROBABILITY AND STATISTICS**				
Course Code	AHSB12				
Programme	B.Tech				
Semester	II	CSE | IT			
	III	AE | ME			
	IV	CE			
Course Type	Foundation				
Regulation	IARE - R18				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	-	-
Chief Coordinator	Dr. S. Jagadha, Associate Professor				
Course Faculty	Ms. P. Srilatha, Assistant Professor Ms. V Subba laxmi, 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, Baye's theorem, random variables, probability distributions, correlation, regression, sampling distribution and testing of hypothesis. 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 modules and each module 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 module. 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 20 marks for Continuous Internal Examination (CIE), 05 marks for Quiz and 05 marks for Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	Theory			Total Marks
Type of Assessment	CIE Exam	Quiz	AAT	
CIA Marks	20	05	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 20 marks of 2 hours duration consisting of five descriptive type questions out of which four 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 - Online Examination

Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)

This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning centre. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (Pos)		Strength	Proficiency assessed by
PO 1	**Engineer knowledge:** Capability to apply the knowledge of Mathematics, Science and Engineering in the field of Mechanical engineering.	3	Presentation on real-world problems
PO 2	**Problem analysis:** An ability to analyze complex engineering problems to arrive at relevant conclusions using knowledge of Mathematics, Science and Engineering.	2	Seminar
PO 4	**Conduct investigation of complex problems:** To design and conduct research oriented experiments as well as to analyze and implement data using research methodologies.	1	Term Paper

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Outcomes (Pos)		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 technologies inputs and managerial skills to become Technocrats.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES :

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	Determine mean and variance of given data by sampling distribution.
IV	Analyze the given data for appropriate test of hypothesis.

IX. COURSE OUTCOMES (COs):

COs	Course Outcome	CLOs	Course Learning Outcome
CO 1	Describe the concept of probability, conditional probability, Baye's theorem and analyze the concepts of discrete, continuous random variables.	CLO 1	Describe the basic concepts of probability.
		CLO 2	Summarize the concept of conditional probability and estimate the probability of event using Baye's theorem.
		CLO 3	Analyze the concepts of discrete and continuous random variables, probability distributions, expectation and variance.
		CLO 4	Use the concept of random variables in real-world problem like graph theory, machine learning.
CO 2	Determine the binomial, poisson and normal distribution to find mean, variance.	CLO 5	Determine the binomial distribution to find mean and variance.
		CLO 6	Understand binomial distribution to the phenomena of real-world problem like sick versus healthy.
		CLO 7	Determine the poisson distribution to find mean and variance.
		CLO 8	Use poisson distribution in real-world problem to predict soccer scores.
		CLO 9	Illustrate the inferential methods relating to the means of normal distributions.
		CLO 10	Describe the mapping of normal distribution in real-world problem to analyze the stock market.
CO 3	Understand multiple random variables and enumerate correlation and regression to the given data.	CLO 11	Explain multiple random variables and the covariance of two random variables.
		CLO 12	Understand the concept of multiple random variables in real-world problems aspects of wireless communication system.
		CLO 13	Calculate the correlation coefficient to the given data.
		CLO 14	Contrast the correlation and regression to the real-world such as stock price and interest rates.

COs	Course Outcome	CLOs	Course Learning Outcome
		CLO 15	Calculate the regression to the given data.
CO 4	Explore the concept of sampling distribution and apply testing of hypothesis for sample means and proportions.	CLO 16	Discuss the concept of sampling distribution of statistics and in particular describe the behavior of the sample mean.
		CLO 17	Understand the foundation for hypothesis testing.
		CLO 18	Summarize the concept of hypothesis testing in real-world problem to selecting the best means to stop smoking.
		CLO 19	Apply testing of hypothesis to predict the significance difference in the sample means.
		CLO 20	Apply testing of hypothesis to predict the significance difference in the sample proportions.
CO 5	Use t-test for means, F-test for variances and chi-square test for independence to determine whether there is a significant relationship between two categorical variables.	CLO 21	Use Student t-test to predict the difference in sample means.
		CLO 22	Apply F-test to predict the difference in sample variances.
		CLO 23	Understand the characteristics between the samples using Chi-square test.

X. 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
AHSB12.01	CLO 1	Describe the basic concepts of probability.	PO 1	3
AHSB12.02	CLO 2	Summarize the concept of conditional probability and estimate the probability of event using Baye's theorem.	PO 2	2
AHSB12.03	CLO 3	Analyze the concepts of discrete and continuous random variables, probability distributions, expectation and variance.	PO 1	3
AHSB12.04	CLO 4	Use the concept of random variables in real-world problem like graph theory; machine learning, Natural language processing.	PO 1	3
AHSB12.05	CLO 5	Determine the binomial distribution to find mean and variance.	PO 2	2
AHSB12.06	CLO 6	Understand binomial distribution to the phenomena of real-world problem like sick versus healthy.	PO 2	2
AHSB12.07	CLO 7	Determine the poisson distribution to find mean and variance.	PO 2	2
AHSB12.08	CLO 8	Use poisson distribution in real-world problem to predict soccer scores.	PO 2	2
AHSB12.09	CLO 9	Illustrate the inferential methods relating to the means of normal distributions.	PO 4	1
AHSB12.10	CLO 10	Describe the mapping of normal distribution in real-world problem to analyze the stock market.	PO 4	1
AHSB12.11	CLO 11	Explain multiple random variables and the covariance of two random variables.	PO 2	2
AHSB12.12	CLO 12	Understand the concept of multiple random variables in real-world problems aspects of wireless communication system.	PO 2	2
AHSB12.13	CLO 13	Calculate the correlation coefficient to the given data.	PO 1	3

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AHSB12.14	CLO 14	Contrast the correlation and regression to the real-world such as stock price and interest rates.	PO 1	3
AHSB12.15	CLO 15	Calculate the regression to the given data.	PO 1	3
AHSB12.16	CLO 16	Discuss the concept of sampling distribution of statistics and in particular describe the behavior of the sample mean.	PO 1, PO 2	3
AHSB12.17	CLO 17	Understand the foundation for hypothesis testing.	PO 1, PO 2	3
AHSB12.18	CLO 18	Summarize the concept of hypothesis testing in real-world problem to selecting the best means to stop smoking.	PO 1, PO 2	3
AHSB12.19	CLO 19	Apply testing of hypothesis to predict the significance difference in the sample means.	PO 1, PO 2	3
AHSB12.20	CLO 20	Apply testing of hypothesis to predict the significance difference in the sample proportions.	PO 1, PO 2	3
AHSB12.21	CLO 21	Use Student t-test to predict the difference in sample means.	PO 1	3
AHSB12.22	CLO 22	Apply F-test to predict the difference in sample variances.	PO 1	3
AHSB12.23	CLO 23	Understand the characteristics between the samples using Chi-square test.	PO 1	3

3= High; 2 = Medium; 1 = Low

XI. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes	Program Outcomes (POs)			Program Specific outcomes (PSOs)
(COs)	PO 1	PO 2	PO 4	PSO1
CO 1	3	2		1
CO 2		2	1	
CO 3	3	2		1
CO 4	3	2		1
CO 5	3			

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

Course Learning 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		2													

Course Learning 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 3	3												1		
CLO 4	3												1		
CLO 5		2													
CLO 6		2													
CLO 7		2													
CLO 8		2													
CLO 9				1											
CLO 10				1											
CLO 11		2											1		
CLO 12		2											1		
CLO 13	3														
CLO 14	3														
CLO 15	3														
CLO 16	3	2											1		
CLO 17	3	2											1		
CLO 18	3	2											1		
CLO 19	3	2											1		
CLO 20	3	2											1		
CLO 21	3														
CLO 22	3														
CLO 23	3														

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XIII. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO1, PO2, PO4,PSO1	SEE Exams	PO1, PO2, PO4,PSO1	Assignments	-	Seminars	PO1, PO2, PO4,PSO1
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	PO1, PO2, PO4,PSO1						

XIV. ASSESSMENT METHODOLOGIES - INDIRECT

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

XV. SYLLABUS

Module-I	PROBABILITY AND RANDOM VARIABLES
Probability, Conditional Probability, Baye's Theorem; Random variables: Basic definitions, discrete and continuous random variables; Probability distribution: Probability mass function and probability density functions; Mathematical expectation.	
Module-II	**PROBABILITY DISTRIBUTION**
Binomial distribution; Mean and variances of Binomial distribution, Recurrence formula for the Binomial distribution; Poisson distribution: Poisson distribution as a limiting case of Binomial distribution, mean and variance of Poisson distribution, Recurrence formula for the Poisson distribution; Normal distribution; Mean, Variance, Mode, Median, Characteristics of normal distribution.	
Module-III	**CORRELATION AND REGRESSION**
Correlation: Karl Pearson's Coefficient of correlation, Computation of correlation coefficient, Rank correlation, Repeated Ranks; Properties of correlation. Regression: Lines of regression, Regression coefficient, Properties of Regression coefficient, Angle between two lines of regression; Multiple correlation and Regression.	
Module-IV	**TEST OF HYPOTHESIS - I**
Sampling: Definitions of population, Sampling, Parameter of statistics, standard error; Test of significance: Null hypothesis, alternate hypothesis, type I and type II errors, critical region, confidence interval, level of significance. One sided test, two sided test. Large sample test: Test of significance for single mean, Test of significance for difference between two sample means, Tests of significance single proportion and Test of difference between proportions.	
Module-V	**TEST OF HYPOTHESIS - II**
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; Chi-square test of goodness of fit.	
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. S. C. Gupta, V. K. Kapoor, "Fundamentals of Mathematical Statistics", S. Chand & Co., 10th Edition, 2000. 2. N. P. Bali, "Engineering Mathematics", Laxmi Publications, 9th Edition, 2016. 3. Richard Arnold Johnson, Irwin Miller and John E. Freund, "Probability and Statistics for Engineers", Prentice Hall, 8th Edition, 2013.	

XVI 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	Define the concept of probability and its applications	CLO 1	T2:26.3
2-3	Describe the concept of conditional probability	CLO 2	R2:21.48
4-5	Describe the Concept of Baye's Theorem	CLO 2	T2:26.6 R2:21.50
6-7	Describe the concept of Random variables, Contrast discrete Random variables and also calculate the mean and variance of discrete Random variables, probability distribution	CLO 3	T2:26.7 R2:21.51
8-9	Recall the continuous probability function	CLO 3	T2:26.8
10-11	Identify mathematical expectation	CLO 3	T2:26.10
12-13	Recall characteristics of the Binomial Distribution and find mean , variance	CLO 5	T2:26.14 R2:21.55
14-15	Recognize cases where Poisson Distribution could be appropriate model to find mean and variance	CLO 7	T2:26.15 R2:21.58
16-18	Apply Normal Distributions find the probability over a set of values, mean and variance	CLO 9	T2:26.16 R2:21.61
19-20	Recognize the limitation of correlation as a summary of bivariate data.	CLO 13	T2:25.12 R2:21.24
21-22	Interpret the correlation between the bivariate data by allotting ranks.	CLO 13	T2:25.16 R2:21.29
23	Define the concept of least squares estimation in linear regression	CLO 15	T2:25.14 R2:21.31
24-25	Estimate the linear model to a bivariate data to the lines regression	CLO 15	T2:25.14 R2:21.33
26-27	Recognize the multiple correlation and regression of bivariate data	CLO 11	R2:21.33
28	Recall the sampling distribution of the sample mean in general situation	CLO 16	T2:27.2 R2:21.64
29	Distinguish between a population and a sample and between parameters & statistics	CLO 16	T2:27.2
30	Recall the sampling distribution and define standard error	CLO 16	T2:27.2 R2:21.67
31-33	Recall the sampling distribution of the sample mean in general situation	CLO 16	T2:27.2
34	Understand the foundation for classical inference involving hypothesis testing and two types of errors possible	CLO 17	T2:27.3 R2:21.71
35	Explain level of significance confidence interval	CLO 17	T2:27.4 R2:21.68
36	Identify the confidence interval with single mean	CLO 19	T2:27.7 R2:21.74
37	Identify the confidence interval with difference between the mean	CLO 19	T2:27.12 R2:21.75
38	Identify the confidence interval with difference between the proportions	CLO 20	T2:27.8 R2:21.72
39	Identify the confidence interval with difference between the proportions	CLO 20	T2:27.8 R2:21.73
40-41	Recall the definition of a t-statistics in terms of statistics of sample from a normal distribution	CLO 21	T2:27.14 R2:21.78

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
42	Apply the definition of F-distribution	CLO 22	T2:27.19 R2:21.814
43	Apply the definition of χ^2 –Distribution	CLO 23	T2:27.12 R2:21.82
44-45	Apply χ^2 - distribution of goodness of fit	CLO 23	T2:27.18 R2:21.82

XVII. 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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