INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

COMPUTER SCIENCE AND ENGINEERING

COURSE INFORMATION SHEET

Course Title	**PROBABILITY AND STATISTICS**			
Course Code	**AHS010**			
Programme	B.Tech			
Semester	II			
Course Type	Core			
Regulation	IARE - R16			
Course Structure	**Lectures**	**Tutorials**	**Practicals**	**Credits**
	3	-	-	3
Course Coordinator	Mr. J Suresh Goud, Assistant Professor			
Course Faculty	Mr. S V S Hanumantha Rao, Associate Professor Ms. P Srilatha, Assistant Professor			

I. COURSE OVERVIEW:

The primary objective of this course is to introduce the concept of algorithm as a precise mathematical concept, and study how to design algorithms, establish their correctness, study their efficiency and memory needs. The course consists of a strong mathematical component in addition to the design of various algorithms.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
Intermediate	-	-	Permutations and combinations	-
Intermediate	-	-	Basic statistics and basic algebra.	-

III. MARKS DISTRIBUTION

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

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.

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

Continuous Internal Examination (CIE):
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 20 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, micro projects, five minutes video and MOOCs.

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

√	CHALK & TALK	√	QUIZ	√	ASSIGNMENTS	X	MOOCs
√	LCD / PPT	√	SEMINARS	X	MINI PROJECT	√	VIDEOS
√	OPEN ENDED EXPERIMENTS						

V. ASSESSMENT METHODOLOGIES – DIRECT

√	CIE EXAMS	√	SEE EXAMS	√	ASSIGNEMNTS	√	SEMINARS
X	LABORATORY PRACTICES	√	STUDENT VIVA	X	MINI PROJECT	X	CERTIFICATION
√	TERM PAPER						

VI. ASSESSMENT METHODOLOGIES – INDIRECT

√	ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE)	√	STUDENT FEEDBACK ON FACULTY (TWICE)
X	ASSESSMENT OF MINI PROJECTS BY EXPERTS		

VII. 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.
IV	**Enrich** more than two population means using ANOVA.

VIII. COURSE LEARNING OUTCOMES (CLOs):

Students, who complete the course, will have demonstrated the ability to do the following:

CAHS010.01	Understand the basic concepts of probability and random variables.
CAHS010.02	Analyze the concepts of discrete and continuous random variables, probability distributions, expectation and variance.
CAHS010.03	Use the concept of random variables in real-world problem like graph theory, machine learning, Natural language processing.
CAHS010.04	Apply the binomial distribution and poisson distribution to find mean and variance.
CAHS010.05	Understand binomial distribution to the phenomena of real-world problem like sick versus healthy.
CAHS010.06	Use poission distribution in real-world problem to predict soccer scores.
CAHS010.07	Apply the inferential methods relating to the means of normal distributions.
CAHS010.08	Understand the mapping of normal distribution in real-world problem to analyze the stock market.
CAHS010.09	Explain multiple random variables and the covariance of two random variables.
CAHS010.10	Understand the concept of multiple random variables in real-world problems aspects of wireless communication system.
CAHS010.11	Calculate the correlation coefficient to the given data.
CAHS010.12	Understand the correlation and regression to the real-world such as stock price and interest rates.
CAHS010.13	Calculate the regression to the given data.
CAHS010.14	Understand the concept of sampling distribution of statistics and in particular describe the behavior of the sample mean.
CAHS010.15	Understand the concept of estimation for classical inference involving confidence interval.
CAHS010.16	Understand the concept of estimation in real-world problems of signal processing.
CAHS010.17	Understand the foundation for hypothesis testing.
CAHS010.18	Understand the concept of hypothesis testing in real-world problem to selecting the best means to stop smoking.
CAHS010.19	Apply testing of hypothesis to predict the significance difference in the sample means.
CAHS010.20	Apply testing of hypothesis to predict the significance difference in the sample proportions.
CAHS010.21	Apply Student t-test to predict the difference in sample means.
CAHS010.22	Apply F-test to predict the difference in sample variances.
CAHS010.23	Understand the characteristics between the samples using Chi-square test.
CAHS010.24	Understand the assumptions involved in the use of ANOVA technique.
CAHS010.25	Understand the concept ANOVA to the real-world problems to measure the atmospheric tides.
CAHS010.26	Understand the knowledge for attempting the competitive exams.

IX. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Level	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.	S	Assignments
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.	S	Assignments
PO 3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	S	Assignments
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.	N	---
PO 5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.	N	---
PO 6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	N	---
PO 7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development..	N	---
PO 8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	N	---
PO 9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	N	---
PO 10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	N	---
PO 11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	N	---
PO 12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	N	---

N= None **S= Supportive** **H = Highly Related**

X. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Level	Proficiency assessed by
PSO 1	**Professional Skills:** The ability to research, understand and implement computer programs in the areas related to algorithms, system software, multimedia, web design, big data analytics, and networking for efficient analysis and design of computer-based systems of varying complexity.	S	Lectures, Assignments
PSO 2	**Problem-Solving Skills:** The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver a quality product for business success.	S	Lectures, Assignments
PSO 3	**Successful Career and Entrepreneurship:** The ability to employ modern computer languages, environments, and platforms in creating innovative career paths, to be an entrepreneur, and a zest for higher studies.	N	-

N - None S - Supportive H - Highly Related

XI. 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, 42nd Edition, 2012.

REFERENCES:

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	l Arnold Johnson, Irwin Miller and John E. Freund, "Probability and Statistics for Engineers", Prentice Hall, 8th Edition, 2013.

XII. COURSE PLAN:

The course plan is meant as a guideline. There may probably be changes.

Lecture No	Course Learning Outcomes (CLOs)	Topic/s to be covered	Reference
1	**Describe** the concept of Random variables and **Contrast** discrete Random variables and calculate the mean and variance of discrete Random variables	**Single random variables and probability distribution** Basic definitions, discrete and continuous random variables; Probability distribution	T1:22.5 R1:2.3
2	**Recall** the continuous probability function	Probability mass function and probability density functions	T1:22.5 R1:2.4
3	**Identify** mathematical mean	Mathematical expectation	T1:22.6 R1:2.6
4-5	**Recall** characteristics of the Binomial Distribution and find mean , variance	Binomial distribution	T1:22.7 R1:4.4
6-7	**Recognize** cases where Poisson Distribution could be appropriate model to find mean and variance	Poisson distribution	T1:22.7 R1:4.10
8-9	**Apply** Normal Distributions find the probability over a set of values, mean and variance	Normal distribution	T1:22.8 R1:4.15
10	**Apply** probability distribution	Joint probability distributions, joint probability mass, density function	T1:22.9 R1:5.4
11	**Apply** marginal probability density function	Marginal probability mass, density functions	T1:22.9 R1:5.8
12-13	**Recognize** the limitation of correlation as a summary of bivariate data.	Coefficient of correlation	T1:23.10 R1:6.8
14	**Interpret** the correlation between the bivariate data by allotting ranks.	Rank correlation	T1:23.10 R1:6.13
15-16	**Define** the concept of least squares estimation in linear regression	Regression coefficient	T1:23.9 R1:7.5
17	**Estimate** the linear model to a bivariate data	The lines of regression	T1:23.10 R1:7.5
18	**Recognize** the multiple correlation of bivariate data	Multiple correlation and regression	T1:23.10 R1:8.1
19	**Recall** the sampling distribution of the sample mean in general situation	Definitions of population, sampling, statistic, parameter	T1:23.1 R1:9.2

20	**Distinguish** between a population and a sample and between parameters & statistics	Types of sampling, Expected values of sample mean and variance	T1:23.1 R1:9.4
21	**Recall** the sampling distribution and define standard error	sampling distribution, standard error	T1:23.1 R1:9.9
22-23	**Recall** the sampling distribution of the sample mean in general situation	sampling distribution of means and sampling distribution of variance	T1:23.1 R1:9.10
24-25	**Interpret** the confidence interval and confidence level	Estimation: Point estimation, interval estimations	T2:27.5 R1:10.2
26	**Understand** the foundation for classical inference involving hypothesis testing and two types of errors possible	Testing of hypothesis: Null hypothesis, alternate hypothesis, type I and type II errors	T2:27.7 R1:11.3
27	**Explain** level of significance confidence interval	Critical region, confidence interval, level of significance. One sided test, two sided test	T2:27.8 R1:11.6
28-30	**Identify** the confidence interval with single mean	Test of hypothesis for single mean	T2:27.12 R1:11.7
31-32	**Identify** the confidence interval with difference between the mean	Test of hypothesis for difference between two sample means	T2:27.12 R1:11.8
33-34	**Identify** the confidence interval with difference between the proportions	Test of hypothesis for single proportion	T2:27.12 R1:11.9
35-36	**Identify** the confidence interval with difference between the proportions	Test of hypothesis for difference between two sample proportions	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	Small sample tests: Student t-distribution, its properties	T2:27.14 R1:12.3
39	**State** and apply the definition of F-distribution	Snedecor's F-distribution and its properties	T2:27.1 R1:12.7
40-41	**State** and apply the definition of χ^2 – Distribution	Chi-square distribution and it's properties	T2:27.17 R1:12.15
42	**Apply** Chi-square distribution	Chi-square test of goodness of fit	T2:27.18 R1:12.19
43-44	**Apply** One way classification	Analysis of variance: One way classification	T2:27.19 R2:14.4
45	**Apply** Two way classification	Two way classification	T2:27.19 R2:14.5

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

S NO	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POs	RELEVANCE WITH PSOs
1	In order to monitor the quality of products to plan effective and efficient designs to improve standards to test and analyze the quality of items	Seminars / Guest Lectures / NPTEL	PO 1, PO 2	PSO 1
2	ANOVA is described, a statistical model is formulated and the advantages of design are discussed.	Seminars / Guest Lectures / NPTEL	PO 2	PSO 2
3	Encourage students based on the taught statements to solve problems.	Assignments / Laboratory Practices	PO 1, PO 2	PSO 1

XIV. MAPPING COURSE OBJECTIVES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Objectives (COs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
I	S	S													
II	S	S													
III	S														
IV	S	S													

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

Course Leaning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CAHS010.01	S	S	S												
CAHS010.02	S	S													
CAHS010.03	S	S	S												
CAHS010.04	S		**S**												
CAHS010.05	S		S												
CAHS010.06	S		S												
CAHS010.07	S	S													
CAHS010.08	S	S													
CAHS010.09		S													
CAHS010.10		S													

CAHS010.11	S	S													
CAHS010.12	S	S													
CAHS010.13	S	S													
CAHS010.14	S														
CAHS010.15	S	S													
CAHS010.16	S	S													
CAHS010.17	S	S													
CAHS010.18	S	S													
CAHS010.19	S		S												
CAHS010.20	S		S												
CAHS010.21		S													
CAHS010.22	S	S													
CAHS010.23	S		S												
CAHS010.24	S	S													
CAHS010.25	S	S													
CAHS010.26	S	S	S												

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XVI. DESIGN BASED PROBLEMS (DP) / OPEN ENDED PROBLEM:

1. Explore the application of distribution of physical measurements on living organism, intelligence test scores, product dimensions, average temperatures.
2. A researcher carefully computes the correlation coefficient between two variables and gets r. What does this value mean?
3. Using the mean of a random sample size, to estimate the mean mechanical aptitude of mechanics of a large workshop and finding probability about the maximum size of error.
4. A group of psychiatric patients are trying three different therapies: counseling, medication and biofeedback. You want to see if one therapy is better than the others.

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