INSTITUTE OF AERONAUTICAL ENGINEERING

(AUTONOMOUS)

Dundigal, Hyderabad - 500 043

COMPUTER SCIENCE AND ENGINEERING

COURSE DESCRIPTION FORM

Course Title	**PROBABILITY AND STATISTICS**			
Course Code	**A30008**			
Regulation	**R13 - JNTUH**			
Course Structure	Lectures	Tutorials	Practical	Credits
	4	1	-	4
Course Coordinator	Mr. J Suresh Goud, Associate Professor, Freshman Engineering			
Team of Instructors	Mr. J Suresh Goud, Associate Professor, Freshman Engineering Mr. L.Indira, Associate Professor, Freshman Engineering Ms. P Srilatha, Assistant Professor, Freshman Engineering			

I. COURSE OVERVIEW:

The course matter is divided into five chapters covering duly-recognized areas of theory and study. This course develops abstract and critical reasoning by studying logical proofs and the axiomatic method as applied to basic probability and to make connections between probability and other branches of mathematics. The topics covered include probability, random variables and distributions, correlation and regression, sampling distribution, testing of hypothesis for large samples and small samples, queuing theory and stochastic process. The course helps students gain an appreciation for the diverse applications of statistics and its relevance to their lives and fields of study.

II. PREREQUISITE(S):

Level	Credits	Periods/ Week	Prerequisites
UG	4	5	Basic Statistics and Algebra

III. MARKS DISTRIBUTION:

Sessional Marks	University End Exam marks	Total marks
Midterm Test There shall be two midterm examinations. Each midterm examination consists of essay paper, objective paper and assignment. The essay paper is for 10 marks of 60 minutes duration and shall contain 4 questions. The student has to answer 2 questions, each carrying 5 marks. The objective paper is for 10 marks of 20 minutes duration. It consists of 10 multiple choice and 10 fill-in-the blank questions, the student has to answer all the questions and each carries half mark. First midterm examination shall be conducted for the first two and half units of syllabus and second midterm examination shall be conducted for the remaining portion. Five marks are earmarked for assignments. There shall be two assignments in every theory course. Assignments are usually issued at the time of	75	100

Sessional Marks	University End Exam marks	Total marks
commencement of the semester. These are of problem solving in nature with critical thinking. Marks shall be awarded considering the average of two midterm tests in each course.		

IV. EVALUATION SCHEME:

S. No	Component	Duration	Marks
1.	I Mid Examination	80 minutes	20
2.	I Assignment	-	5
3.	II Mid Examination	80 minutes	20
4.	II Assignment	-	5
5.	External Examination	3 hours	75

V. COURSE OBJECTIVES:

At the end of the course, the students will be able to:

I. Expose students to the elements of probability, probability distributions and statistical inference.
II. Provide an introduction to probability and statistics with applications.
III. Develop an understanding about the role of statistics in engineering.
IV. Develop an understanding about the application of statistical analysis to solve real-life problems.

VI. COURSE OUTCOMES:

After completing this course the student must demonstrate the knowledge and ability to:

1. **Recall** the basics of permutation and combination.
2. **Demonstrate** an understanding of the basic concepts of probability and random variables.
3. **Classify** the types of random variables and calculate mean and variance.
4. **Recognize** where the Binomial Distribution and Poisson distribution could be appropriate model and find mean & variance of the distributions.
5. **Apply** the inferential methods relating to the means of Normal Distributions.
6. **Explain** multiple random variables and covariance of two random variables.
7. **Calculate** the correlation and regression to the given data.
8. **Understand** the concept of sampling distribution of statistics and in particular describe the behavior of the sample mean.
9. **Understand** the foundation for classical inference involving confidence interval and hypothesis testing.
10. **Apply** testing of hypothesis for large samples and small samples.
11. **Describe** the queuing system, mean arrival and service rates.
12. **Calculate** expected queue length and waiting lines.
13. **Define** random process, Markov chain and stochastic matrix and limiting probabilities.
14. **Calculate** the gambler ruin for the given data.

VII. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes		Level	Proficiency assessed by
PO1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	H	Assignments, Tutorials
PO2	**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.	H	Assignments
PO3	**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
PO4	**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.	S	Assignments
PO5	**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	--
PO6	**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	--
PO7	**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	--
PO8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	N	--
PO9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	N	--
PO10	**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	--
PO11	**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	--
PO12	**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**

VIII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes		Level	Proficiency assessed by
PSO1	**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
PSO2	**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	Assignments
PSO3	**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.	S	Guest Lectures

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

IX. SYLLABUS:

UNIT-I

Single Random variable and probability distribution: Random Variable-Discrete and continuous. probability distributions, mass function/density function of a probability distribution. mathematical expectation, moments about origin, central moments. Moment generating function of probability distribution. Binomial, passion & normal distributions and their properties. Moment generating functions of the above three distributions and hence find the mean and variance

UNIT-II

Multiple Random variables, Correlation & Regression: Joint probability distribution-joint probability mass/density function, marginal probability mass/density function, covariance of two random variables, correlation-coefficient of correlation, the rank correlation Regression-Regression coefficient. The lines of regression and multiple correlation & regression.

UNIT-III

Sampling Distribution and Testing of Hypothesis:

Sampling: Definition 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.

Parameter estimation-likelihood estimation, interval estimation.

Testing of Hypothesis: Null hypothesis, alternative hypothesis, type-I &type II errors-critical region, confidence interval, level of significance, one sided test, two sided test.

Large sample tests:

i) Test of equality of means of two samples equality of sample mean and population mean(cases of known variance & unknown variance, equal and unequal variances)
ii) Tests of significance difference between sample S.D and population S.D
iii) Tests of significance difference between sample proportion and population proportion & difference between two samples proportions.

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 equality of two population variances, Chi-square distribution and its properties, Chi-square test of goodness of fit

UNIT-IV

Queuing Theory: Structure of a queuing system,operating characteristics of queuing syatem.Transient and steady states,terminology of queuing system,arrival and service processes-pure birth-death process-deteministic queuing models-M/M/1 model of infinite queue,M/M/1 model finite queue.

UNIT-V

Stochastic processes: Introduction to stochastic process-classification of random processes,methods of description of random processes,stationary and non-stationary random process,average values of single random process and two or more random process.Markov process,Markov chain,classification of states-examples of Markov chains,Stochastic matrix.

Text Books:

1. Dr. B. S. Grewal, "Higher Engineering Mathematics", Khanna publishers.
2. Sheldon M Ross, "Probability and Statistics for Engineering and Scientists", Academic press.
3. S. D. Sarma, "Operation Research".

Reference Books:

1. K. B. Datta and M.A.S.Srinivas, "Mathematics for Engineering", Cengage Publications.
2. T. K. V. Iyengar, B. Krishna, "Probability and Statistics", Gandhi Et.
3. S. C. Gupta and V. K. Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand & Sons.
4. Jay I Devore, "Probability and Statistics for Engineers and Scientists", California, 2004.

X. COURSE PLAN:

At the end of the course, the students are able to achieve the following course learning outcomes:

Lecture No.	Topics to be covered	Course Learning Outcomes	References
1	Single random variables and probability distributions: Introduction to probability	**Demonstrate** an understanding of the basic concept of probability and random variables	T1,R2
2	Definition of random variable	**Describe** the concept of random variables	T1,R2
3	Discrete probability distributions	**Contrast** discrete random variables and calculate the mean and variance of discrete random variables	T1,R2
4	Continuous probability Distributions	**Contrast** continuous Random variables and calculate the mean and variance of continuous Random variables	T1,R2
5	Density function of a probability Distribution	**Recall** the continuous probability function	T1,R2
6	Mathematical expectation, moment about origin	**Identify** mathematical mean and find moment about origin	T1,R2
7	Central moments, moment generating function of a probability distribution	**Generalize** central moments and moment generating functions of a probability distribution	T1,R2
8-9	Binomial distribution	**Recall** characteristics of the Binomial Distribution and find mean , variance	T1,R2

10-11	Poisson distribution	**Recognize** cases where Poisson Distribution could be appropriate model to find mean and variance	T1,R2
12-14	Normal distribution and their Properties	**Apply** Normal Distributions find the probability over a set of values, mean and variance	T1,R2
15	Moment generating functions of three distributions	**Apply** probability distribution to find moment generating functions	T1,R2
16	Multiple random variables, correlation and regression: Introduction joint probability Distribution	**Recall** the properties of sample correlation and identify which variable in Regression Analysis	T1,R2
17	Joint probability mass or density Function	**Apply** probability distribution	T1,R2
18-19	Marginal probability mass or density function	**Apply** marginal probability density function	T1,R2
20	Covariance of two random Variables	**Identify** the covariance of two random variables	T1,R2
21	Coefficient of correlation	**Recognize** the limitation of correlation as a summary of bivariate data.	T1,R2
22	Rank correlation	**Interpret** the correlation between the bivariate data by allotting ranks.	T1,R2
23-24	Regression coefficient	**Define** the concept of least squares estimation in linear regression	T1,R2
25-26	The lines of regression	**Estimate** the linear model to a bivariate data	T1,R2
27-28	Multiple correlation and regression	**Recognize** the multiple correlation of bivariate data	T1,R2
29	Sampling distribution and testing of hypothesis: definitions of sampling distributions	**Recall** the sampling distribution of the sample mean in general situation	T1,R2
30-31	Types of sampling, expected values of sample mean and Variance	**Distinguish** between a population and a sample and between parameters & statistics	T1,R2
32-33	Sampling distributions of means and variance	**Recall** the sampling distribution of the sample mean in general situation	T1,R2
34-35	Estimations	**Interpret** the confidence interval and confidence level	T1,R2
36	Testing of hypothesis	**Understand** the foundation for classical inference involving hypothesis testing	T1,R2
37	Procedure for testing of hypothesis	**Explain** the procedure and two types of errors possible	T1,R2
38	Testing of hypothesis with single Mean	**Identify** the confidence interval with single mean	T1,R2
39-40	Testing of hypothesis with difference of means	**Identify** the confidence interval with difference between the mean	T1,R2
41-42	Testing of hypothesis with single Proportion	**Identify** the confidence interval with difference between the proportions	T1,R2

43-44	Testing of hypothesis with difference of proportions	**Identify** the confidence interval with difference between the proportions	T1,R2
45-46	Student's t-tests and its properties	**Recall** the definition of a t-statistics in terms of statistics of sample from a normal distribution	T1,R2
47-48	F-test	**State** and apply the definition of F-distribution	T1,R2
49-50	χ^2-test	**State** and apply the definition of χ^2 – Distribution	T1,R2
51	Queuing theory: Introduction to queuing theory	**Apply** Poisson process in finding arrival and departure rates.	T3,R2
52	Structure of queuing system	**Define** and explain basic concepts in the theory Markov processes, M/M/1 queuing systems	T3,R2
53	Characteristics of queuing system	**Derive** and apply main formulas for some properties (such as stationary probabilities, average waiting and system time, expected number of customers in the queue, etc.) of M/M/1 queuing systems.	T3,R2
54	Transient and steady state	**Analyse**and solve problems	T3,R2
55	Pure birth and death process	**Calculate** the traffic intensity, blocked traffic and the utilization of some queuing systems	T3,R2
56	M/M/1-model -1	**Define** and explain basic concepts in the theory Markov processes, M/M/1 queuing systems	T3,R2
57	M/M/1-model -2	**Define** and explain basic concepts in the theory Markov processes, M/M/1 queuing systems	T3,R2
58	Stochastic process: introduction to stochastic processes	**Understand** the theory of multivariate data	T3,R2
59	Classification of random processes	**Classify** different types of random processes	T3,R2
60	Markov process	**Define** and explain basic concepts in the theory Markov processes	T3,R2
61	Classification of state	**Classify** different states of Markov process	T3,R2
62	Markov chains	**Understand** the concept of Markov chain	T3,R2
63	Stochastic matrix	**Define** stochastic matrix and apply the process to practical problems	T3,R2

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

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

S – Supportive **H - Highly Related**

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

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	H	H	S										S	S	
2	H	S											S		
3	S	S		S										S	
4	H												S		
5	S		H										S		
6	H													S	
7		H											S		
8	H													S	
9		S											S		
10		S	S										S		
11	S													S	
12	H			S									S		
13	S		S											S	S
14	H												S		

S – Supportive **H - Highly Related**

Prepared By : Mr. J Suresh Goud, Associate Professor, Freshman Engineering

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