School of Computer Science and Engineering

Department of Computer Science and Engineering

Engineering Mathematics IV | MA2201| 3 Credits | 2 1 0 3

Session: January 2024– May 2024 | Faculty: Dr Alka Choudhary | Class: B.Tech. IV Sem

A. Introduction: This course is offered by Dept. of Mathematics & Statistics as a regular course to make the students acquainted with the subject of probability and statistics at an early stage. Probability and statistics is an important foundation for computer science fields such as machine learning, artificial intelligence, computer graphics, randomized algorithms, image processing, and scientific simulations. In this course, students will expand their knowledge of probabilistic methods and apply them to diverse computational problems. The first part of the course offers in depth knowledge of probability theory (random event, probability, characteristics of random variables, probability distributions and moment generating functions) which is necessary for simulation of random processes. In the second part, sampling theory is discussed. Each concept is explained through various examples and application-oriented problems.

B. Course Outcomes: At the end of the course, students will be able to

[2201.1] Apply the concept of probability and related theorems in solving various real-world problems.

[2201.2] Understand the key concept of random variable, its probability distributions including mean, expectation, variance and moments.

[2201.3] Implement the variation and the relation between two random variables by using the concept of correlation.

[2201.4] Comprehend the concept of random sample and its sampling distribution which will enhance the logical & analytical skills.

[2201.5] Apply the statistics for testing the significance of the given large and small sample data by using t-test, F-test and Chi-square test.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

PO1. Engineering knowledge: Apply the knowledge of mathematics, computer science, and communication engineering fundamentals to the solution of complex engineering problems.

PO2. Problem analysis: The sophisticated curriculum would enable a graduate to identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using basic principles of mathematics, computing techniques and communication engineering principles.

PO3. Design/development of solutions: Upon analysing, the B Tech CSE graduate should be able to devise solutions for complex engineering problems and design system components or processes that meet the specified requirements with appropriate consideration for law, safety, cultural & societal obligations with environmental considerations.

PO4. Conduct investigations of complex problems: To imbibe the inquisitive practices to have thrust for innovation and excellence that leads to 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.

PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6. The engineer and society: The engineers are called society builders and transformers. B. Tech CSE graduate should be able to 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.

PO7. Environment and sustainability: The zero effect and zero defect is not just a slogan, it is to be practised in each action. Thus, a B Tech CSE should understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. Ethics: Protection of IPR, staying away from plagiarism are important. Student should be able to apply ethical principles and commit to professional ethics, responsibilities, and norms of the engineering practice.

PO9. Individual and teamwork: United we grow, divided we fall is a culture at MUJ. Thus, an outgoing student should be able to function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. Communication: Communicate effectively for all engineering processes & activities with the peer engineering team, community and with society at large. Clarity of thoughts, being able to comprehend and formulate effective reports and design documentation, make effective presentations, and give and receive clear instructions.

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 varied environments.

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.

Program Specific Outcomes (PSOs)

At the end of the B. Tech. CSE program, the student:

PSO1. Imbibe the basic concepts and applications of computer-based Communication or networking, information sharing, signal processing, web-based systems, smart devices, and communication technology.

PSO2. Investigate prominent areas in the field of Computer and Communication Engineering to provide feasible solutions.

PSO3. Apply the contextual knowledge in the field of Computing and Communication to assess social, health, safety, and security issues relevant to the professional engineering practice.

D.   Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	**Sessional Exam**	**30**
	CWS Marks based on Quizzes and Assignments.	**30**
End Term Exam (Summative)	**End Term Exam**	**40**
	Total	**100**
Attendance (Formative)	A minimum of 75% Attendance required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Homework/ Home Assignment/ Activity Assignment (Formative)	Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal.	

E.   SYLLABUS

Basic Set theory, Axioms of probability, Sample space, conditional probability, total probability theorem, Baye's theorem. One dimensional and two dimensional random variables, mean and variance, properties, Chebyschev's inequality, correlation coefficient, Distributions, Binomial, Poisson, Normal and Chisquare. Functions of random variables: One dimensional and Two dimensional, F & T distributions, Moment generating functions, Sampling theory, Central limit theorem, Point estimation, MLE, Interval estimation, Test of Hypothesis: significance level, certain best tests; Chi square test.

References:

1. P. L. Meyer, Introduction to probability and Statistical Applications, (2e), Oxford and IBH publishing, 1980.
2. Miller, Freund and Johnson, Probability and Statistics for Engineers, (8e), Prentice Hall of India, 2011.
3. Hogg and Craig, Introduction to mathematical statistics, (6e), Pearson Education, 2012.
4. Sheldon M Ross, Introduction to Probability and Statistics for Engineers and Scientists, Elsevier, 2010

F. LECTURE PLAN

Lecture Number	Topic	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Introduction of the Course	Develop the understanding about the course	Lecture, Discussion & Examples	NA	NA
2	Basic Set Theory	Students will get the acquaintance with the basic concept of Set Theory	Lecture, Discussion & Examples	2201.1	Quiz, Sessional & End Term Exam
3	Axioms of Probability	Learn about the basic concept of Probability	Lecture, Discussion & Examples	2201.1	Quiz, Sessional & End Term Exam
4	Conditional Probability	Understand the Conditional Probability	Lecture, Discussion & Examples	2201.1	Quiz, Sessional & End Term Exam
5	Total Probability Theorem	Learn about Total Probability Theorem	Lecture, Discussion & Examples	2201.1	Quiz, Sessional & End Term Exam
6	Baye's Theorem	Learn about Baye's Theorem	Lecture, Discussion & Examples	2201.1	Quiz, Sessional & End Term Exam
7	Tutorial-Problem Solving Session	Apply the concepts in real world problems	Discussion & Examples	2201.1	Quiz, Sessional & End Term Exam
8	Random Variable: One Dimensional	Learn about Random Variable	Lecture, Discussion & Examples	2201.2	Quiz, Sessional & End Term Exam
9	Classification: Discrete & Continuous Random Variable	Understand the classification of Random Variables	Lecture, Discussion & Examples	2201.2	Quiz, Sessional & End Term Exam
10	Random variable: Two Dimensional	Elaborate the concept of Random Variable in two dimensions	Lecture, Discussion & Examples	2201.3	Quiz, Sessional & End Term Exam
11	Joint Distribution Function	Get the knowledge of Joint Distribution Function	Lecture, Discussion & Examples	2201.3	Quiz, Sessional & End Term Exam
12	Marginal Distribution & Conditional Distribution	Get the knowledge of Marginal & Conditional Distributions	Lecture, Discussion & Examples	2201.3	Quiz, Sessional & End Term Exam
13	Mathematical Expectation and Variance	Develop the notion of Mean & variance	Lecture, Discussion & Examples	2201.2	Quiz, Sessional & End Term Exam
14	Moments & Moment Generating Function	Elaborate the concept of Mgf	Lecture, Discussion & Examples	2201.2	Quiz, Sessional & End Term Exam

15	Tutorial-Problem Solving Session	Apply the concepts in real world problems	Discussion & Examples	2201.2	Quiz, Sessional & End Term Exam
16	Functions of Random Variables	Develop the notion of Functions of Random Variables	Lecture, Discussion & Examples	2201.3	Quiz, Sessional & End Term Exam
17	Covariance	Understand the concept of Covariance	Lecture, Discussion & Examples	2201.3	Quiz, Sessional & End Term Exam
18	Conditional Expectation	Elaborate the notion of Expectation	Lecture, Discussion & Examples	2201.3	Quiz, Sessional & End Term Exam
19	Correlation Coefficient	Calculate the Correlation Coefficient	Lecture, Discussion & Examples	2201.3	Quiz, Sessional & End Term Exam
20	Chebyschev's Inequality	Understand the concept of Chebyschev's Inequality	Lecture, Discussion & Examples	2201.2	Quiz, Sessional & End Term Exam
21	Tutorial-Problem Solving Session	Apply the concepts in real world problems	Discussion & Examples	2201.3	Quiz, Sessional & End Term Exam
22	Probability Distributions: Binomial Distribution	Get the knowledge of Binomial Distribution	Lecture, Discussion & Examples	2201.2	Quiz, Sessional & End Term Exam
23	Poisson Distribution	Get the knowledge of Poisson Distribution	Lecture, Discussion & Examples	2201.2	Quiz, Sessional & End Term Exam
24	Normal Distribution	Get the knowledge of Normal Distribution	Lecture, Discussion & Examples	2201.2	Quiz, Sessional & End Term Exam
25-27	Brief overview about Sampling Theory	Develop the concept of Sampling Theory	Lecture, Discussion & Examples	2201.4	Quiz, Sessional & End Term Exam
28	Point Estimation	Understand the concept of estimators	Lecture, Discussion & Examples	2201.4	Quiz, Sessional & End Term Exam
29	MLE (Maximum Likelihood Estimate)	Understand the concept of estimators	Lecture, Discussion & Examples	2201.4	Quiz, Sessional & End Term Exam
30	Central Limit Theorem	Understand the concept of Central Limit Theorem	Discussion & Examples	2201.4	Quiz, Sessional & End Term Exam
31	Interval Estimation	Understand the concept of estimators	Lecture, Discussion & Examples	2201.4	Quiz, Sessional & End Term Exam
32	Tutorial-Problem Solving Session	Apply the concepts in real world problems	Discussion & Examples	2201.4	Quiz & End Term Exam
33	Testing of Hypothesis: Statistical Hypothesis, Null Hypothesis, Alternate Hypothesis & Types of Error	Analyze the Hypothesis	Lecture, Discussion & Examples	2201.5	Quiz & End Term Exam
34	Level of Significance & Critical Region	Analyze the Hypothesis	Lecture, Discussion & Examples	2201.5	Quiz & End Term Exam
35	Procedure for Testing of Hypothesis	Analyze the Hypothesis	Lecture, Discussion & Examples	2201.5	Quiz & End Term Exam

36	t-Distribution	Understand t-Distribution	Lecture, Discussion & Examples	2201.2	Quiz & End Term Exam
37	Test of Significance based on t-Distribution	Apply the tests of Hypothesis	Lecture, Discussion & Examples	2201.5	Quiz & End Term Exam
38	F- Distribution	Understand F-Distribution	Lecture, Discussion & Examples	2201.2	Quiz & End Term Exam
39	Test of Significance based on F-Distribution	Apply the tests of Hypothesis	Lecture, Discussion & Examples	2201.5	Quiz & End Term Exam
40	Chi-square Distribution	Understand Chi-square Distribution	Lecture, Discussion & Examples	2201.2	Quiz & End Term Exam
41	Chi square Test	Apply the tests of Hypothesis	Lecture, Discussion & Examples	2201.5	Quiz & End Term Exam
42	Tutorial-Problem Solving	Apply the concepts in real world problems	Discussion & Examples	2201.5	Quiz & End Term Exam

G. COURSE ARTICULATION MATRIX (MAPPING OF COs WITH POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
MA2201.1	Apply the concept of probability and related theorems in solving various real-world problems.	3	2	1	2	1	2	3	3	2	1	2	1	3	2	1
MA2201.2	Understand the key concept of random variable, its probability distributions including mean, expectation, variance and moments.	3	2	1	2	1	1	3	3	2	1	2	1	3	1	2
MA2201.3	Implement the variation and the relation between two random variables by using the concept of correlation.	3	2	1	2	1	1	3	3	2	1	2	1	3	1	1
MA2201.4	Comprehend the concept of random sample and its sampling distribution which will enhance the logical & analytical skills.	3	2	1	2	1	2	3	3	2	1	2	1	2	2	2
MA2201.5	Apply the statistics for testing the significance of the given large and small sample data by using t-test, F-test and Chi-square test.	3	2	1	2	1	2	3	3	2	1	2	1	3	3	2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

H. Course Outcome Attainment Level Matrix:

CO	STATEMENT	ATTAINMENT OF PROGRAM OUTCOMES THRESHOLD VALUE: 40%												ATTAINMENT OF PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
2201.1	Apply the concept of probability and related theorems in solving various real-world problems.															
2201.2	Understand the key concept of random variable, its probability distributions including mean, expectation, variance and moments.															
2201.3	Implement the variation and the relation between two random variables by using the concept of correlation.															
2201.4	Comprehend the concept of random sample and its sampling distribution which will enhance the logical & analytical skills.															
2201.5	Apply the statistics for testing the significance of the given large and small sample data by using t-test, F-test and Chi-square test.															

0-No Attainment; 1- Low Attainment; 2- Moderate Attainment; 3- Substantial Attainment