

**Statistics Paper -II**  
**Mathematical Statistics**  
**[CORE COURSE]**

<b>Semester I</b>	<b>Credits: 2</b>	<b>Subject Code: BS12006</b>	<b>Lectures : 40</b>
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**Course outcomes:**

**At the end of this course, the learner will be able to:**

- Apply methods of Counting Principles, Permutation, and Combination to real life situations.
- Ability to apply concepts of experiments, sample space, events required in the calculation of probabilities.
- Use the basic probability rules, including additive and multiplicative laws, using the terms, independent and mutually exclusive events.
- Translate real-world problems into probability models.
- Calculate conditional probabilities of random variables.
- Apply discrete and continuous probability distributions to various real life problems.

<b>Unit 1: Theory of Probability</b>	<b>10</b>
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- Counting Principles, Permutation, and Combination.
- Deterministic and non-determination models.
- Random Experiment, Sample Spaces (Discrete and continuous)
- Events: Types of events, Operations on events.
- Probability - classical definition, probability models, axioms of probability, Probability of an event.
- Theorems of probability (without proof)
  - i)  $0 \leq P(A) \leq 1$  ii)  $P(A) + P(A^c) = 1$  iii)  $P(\Phi) = 0$  iv)  $P(A) \leq P(B)$  when  $A \subset B$
  - iv)  $P(A \cup B) = P(A) + P(B) - P(A \cap B)$
- Numerical problems related to real life situations.

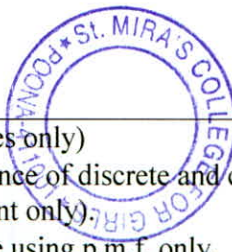
<b>Unit 2: Conditional Probability and Independence</b>	<b>08</b>
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- Concepts and definitions of conditional probability, multiplication theorem  $P(A \cap B) = P(A) \cdot P(B|A)$
- Bayes' theorem (without proof). True positive, false positive and sensitivity of test as application of Bayes' theorem.
- Concept of Posterior probability, problems on posterior probability.
- Concept and definition of independence of two events.
- Numerical problems related to real life situations.

<b>Unit 3: Random variable</b>	<b>10</b>
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- Definition of random variable (r.v.), discrete and continuous random variable.
- Definition of probability mass function (p.m.f.) of discrete r.v. and Probability density function of continuous r.v..
- Cumulative distribution function (c.d.f.) of discrete and continuous r.v. and their

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<p>properties. (Characteristic properties only)</p> <ul style="list-style-type: none"> <li>• Definition of expectation and variance of discrete and continuous r.v., theorem on expectation and variance (statement only)</li> <li>• Determination of median and mode using p.m.f. only.</li> <li>• Numerical problems related to real life situations.</li> </ul>	
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<b>Unit 4: Standard Discrete Distributions</b>	<b>12</b>
<ul style="list-style-type: none"> <li>• Discrete Uniform Distribution: definition, mean, variance.</li> <li>• Binomial Distribution: definition, mean, variance, additive property, Bernoulli distribution as a particular case with <math>n=1</math>.</li> <li>• Geometric Distribution (p.m.f <math>p(x) = pq^x</math>, <math>x=0,1,2, \dots</math>): definition, mean, variance.</li> <li>• Poisson Distribution: definition, mean, variance, mode, additive property, limiting Case of <math>B(n, p)</math>, Illustration of real life situations.</li> <li>• Numerical problems related to real life situations.</li> <li>• Only statement of mean and variance, derivation is not expected.</li> </ul>	

<b>Recommended Text Books:</b>
<ul style="list-style-type: none"> <li>• Gupta S. C. and Kapoor V. K. 1987, <i>Fundamentals of Applied Statistics (3rd Edition)</i> S. Chand and Sons, New Delhi.</li> <li>• Kulkarni M.B., Ghatpande S.B., Gore S.D. 1999; <i>Common Statistical Tests</i>, Satyajeet Prakashan, Pune</li> <li>• Kulkarni M.B., Ghatpande S.B. 2007, <i>Introduction to Discrete Probability and Probability Distributions</i> SIPF Academy</li> <li>• Sarma K.V.S. 2001 <i>Statistics Made Simple. Do it Yourself on P.C.</i> Prentice Hall</li> </ul>

<b>Reference Books:</b>
<ul style="list-style-type: none"> <li>• Agarwal B. L., <i>Programmed Statistics</i>, New Age International Publishers.</li> <li>• Freund J.E., <i>Modern Elementary Statistics</i>, Pearson Publication 2005.</li> <li>• Kulkarni M.B., Ghatpande S.B., <i>Introduction to Discrete Probability and Probability Distributions</i>, SIPF Academy, 2007.</li> <li>• Medhi J., <i>Statistical Methods (An Introductory Text)</i>, New Age International, 1992.</li> <li>• Mukhopadhyay P. <i>Mathematical Statistics (3rd Edition)</i>, Books And Allied (P), Ltd 2015.</li> <li>• Probability, Statistics, <i>Design of Experiments and Queuing Theory with Applications of Computer Science</i>, Trivedi K.S., Prentice Hall of India, New Delhi 2001.</li> <li>• Sheldon Ross, <i>A First course in Probability</i>, Pearson Education Inc.</li> </ul>

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